United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
2800 Cottage Way, Suite W-2605
Sacramento, California 95825-1846

In Reply Refer to:
FF08ESMF00-
2014-F-0557

DEC 19 2014

Mr. Randy Moore
Regional Forester
Pacific Southwest Region
U.S. Forest Service
1323 Club Drive
Vallejo, California 94592

Subject: Programmatic Biological Opinion on Nine Forest Programs on Nine National Forests in the Sierra Nevada of California for the Endangered Sierra Nevada Yellow-legged Frog, Endangered Northern Distinct Population Segment of the Mountain Yellow-legged Frog, and Threatened Yosemite Toad

Dear Mr. Moore:

This is in response to your June 16, 2014, request for programmatic consultation with the U.S. Fish and Wildlife Service (Service) on nine forest programs for nine National Forests in the Sierra Nevada of California for the endangered Sierra Nevada yellow-legged frog (*Rana sierrae*), endangered Northern Distinct Population Segment of the mountain yellow-legged frog (*Rana mucosa*), and threatened Yosemite toad (*Anaxyrus canorus*) (collectively hereinafter "three listed amphibians" or "three listed species"). At issue are the programmatic adverse effects on these three listed amphibians. Your letter was received by the Service on June 16, 2014. This biological opinion is issued under the authority of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*)(Act).

Many of the published peer-reviewed papers and unpublished reports on the Sierra Nevada yellow-legged frog and the Northern Distinct Population Segment of the mountain yellow-legged frog were issued prior to the analysis and taxonomic reclassification by Vredenburg *et al.* (2007). These two species have undergone elevation of subspecies and other changes in their systematics and taxonomy; possess similar morphologies, behaviors, biologies, and ecologies; and within this programmatic biological opinion when the information applies to both animals, they will be collectively referred to as "mountain yellow-legged frog."

This programmatic biological opinion is based on: (1) letter from the Forest Service to the Service dated June 16, 2014, requesting initiation of formal consultation for the nine Forest programs; (2) Biological Assessment *(BA) for Actions that Affect the Sierra Nevada yellow-legged frog, N. DPS. Mountain*

yellow-legged frog, and Yosemite toad on National Forest Lands in the Sierra Nevada dated June 13, 2014, (BA) that was prepared by the Forest Service; (5) *draft Status of the Mountain Yellow-legged Frog, Yosemite Toad and Pacific Chorus Frog in the Sierra Nevada, CA* dated April 2011 prepared by the U.S. Forest Service (USFS); (6) *Habitat Definitions for the USFS Programmatic BA* (Habitat Definitions) undated, but received from the Forest Service on June 3, 2014; and (7) other information available to the Service.

The conservation measures in this biological opinion are the Standard and Guides (S&Gs) in the 2004 Sierra Nevada Forest Plan Amendment Record of Decision (Appendix A) and the Region 5 Best Management Practices (BMPs) (Appendix B). The S&Gs and BMPs were rewritten for clarification and to more directly show their application to the conservation of the three amphibian species; the intent is to reflect the S&Gs and BMPs. It is understood that minor project specific adjustments to the conservation measures may be needed for site specific conditions, and that these projects may be appended to this programmatic biological opinion. In these cases, the biological rationale for changes must be clearly articulated as part of the project description included in the biological opinion appendage.

During emergency activities such as wildfire suppression, the Forest Service should initiate emergency consultation in accordance with the section 7 implementation regulations as outlined in 50 CFR § 402. The Service considers the protection of firefighters and other personnel to be of paramount importance.

Consultation History

A comprehensive list of the dates, participants, and topics discussed are included in the BA. The relevant events that have occurred since June 16, 2014 are as follows:

June 13, 2014	The Forest Service, Service, California Farm Bureau, California Cattlemen's Association, California Woolgrower's Association, and the University of California at Davis, met about issues regarding livestock grazing and the programmatic consultation. It was agreed that the project should include a scientific and statistically valid monitoring program focused on the effects of livestock grazing on the Yosemite toad, Sierra Nevada yellow-legged frog, and the Northern Distinct Population Segment of the mountain yellow-legged legged frog.
July 24, 2014	The Service provided the Forest Service with a draft project description.
August 1, 2014	The Service received edits and comments from the Forest Service on the draft project description.
August 20, 2014	The Service sent the draft programmatic biological opinion to the Forest Service.
September 2014 - December 2014	The Service received comments on the draft programmatic biological opinion from the Forest Service and met with the Forest Service to address these comments.

PROGRAMMATIC BIOLOGICAL OPINION

Description of the Proposed Action

The proposed action is implementation of projects and actions under nine Forest programs in nine National Forests in the Sierra Nevada. The nine National Forests are the Lassen, Plumas, Tahoe, Eldorado, Stanislaus, Sierra, Inyo, and Sequoia National Forests and the Lake Tahoe Basin Management Unit. This project description has been prepared programmatically and includes standard conservation measures appropriate to each program. Individual projects may be appended to this programmatic biological opinion alone or in batches so long as they are consistent with the BA, and the Service has agreed that their inclusion is appropriate.

The projects submitted for appendage by the Forest Service will be from one of nine Forest programs: 1) timber harvest, vegetation management, fuels management, and watershed restoration; 2) road and trail maintenance; 3) maintenance of developed recreation and administrative infrastructure; 4) special use permits; 5) rangeland management; 6) biological resources management; 7) invasive species management; 8) mining; and 9) lands and real estate.

Conservation measures for each program have been developed in consultation with the Service. These measures are designed to reduce adverse effects to the three listed amphibians. Their full implementation by the Forest Service is an essential component of this programmatic consultation.

If the Service does not concur the project is appropriate for appendage to this programmatic biological opinion, the Forest Service will be notified in writing. The Service will re-evaluate this programmatic consultation at appropriate intervals to ensure that its continued application does not result in additional unanticipated effects to the three listed amphibians, or suitable habitat. In the event that the Forest Service committed conservation measures are not completely incorporated into the specific design of each project, site-specific characteristics may lead to effects not considered this programmatic biological opinion, or the Service has determined the project is not consistent with the BA and therefore not appropriate for being appended to this document, the Forest Service must consult separately for the specific project in question.

<u>Procedures for Appending Projects to the Programmatic Biological Opinion</u>

The following information will be provided to the Service by the Forest Service for each project submitted for appendage, and used to evaluate whether the project may be appended to this programmatic biological opinion:

1. The Forest Service will submit a project or list of projects in the nine Forest programs for which appendage to the programmatic biological opinion is requested.

2. The Forest Service will make one of the following effect determinations for the project on the Sierra Nevada yellow-legged frog, and/or the Northern Distinct Population Segment of the mountain yellow-legged frog, and Yosemite toad:

    a. May affect, not likely to adversely affect: The Forest Service will submit the appropriate biological and other pertinent information and a letter requesting concurrence with the

determination from the Service. The Service will send a letter to the Forest Service if we concur with the determination; concurrences will not be appended to this programmatic biological opinion.

b. May affect, likely to adversely affect: The Forest Service will submit the appropriate biological and other pertinent information along with a letter requesting that the proposed project to be appended to this programmatic biological opinion.

3. For each project, the Forest Service will include the following information, but may not be limited to:

a. Site-specific analysis of Forest Service actions from potential effects to suitable habitat and known occurrences of the three listed amphibians. The site-specific analyses of each individual projects and activities will be included in the BA.

i. Project name
ii. Ranger District
iii. NEPA name
iv. Decision date
v. PALS dBase Number
vi. Project implementation date(s)
vii. Location
viii. If survey(s) have been conducted, including dates
ix. Total project area acres
x. Which of the three listed amphibian species may be affected
xi. Clade affected (if known)
xi. Acres of suitable habitat affected by the project
xii. Occupied acres affected
1) acres of utilized habitat
2) acres of unknown habitat
3) acres of unutilized habitat
xiii. If the project is located within or may affect proposed critical habitat, if so, name(s) of the unit
xiv. Specific project design criteria, if any, for the three amphibians
xv. Distance to closest population of the appropriate listed amphibian
xvi. Forest Service contact person

b. For each project, the Forest Service will include Geographic Information System (GIS) data, maps, aerial photos, landscape photos, or other information as appropriate and available.

c. In the case of multiple projects submitted to the Service at one time, the Forest Service will include a summary table for each of the nine National Forests with the following information on each of the three listed amphibians and the nine Forest programs:

i. Activity (program) type
ii. Total acres within project areas
iii. Total project acres in Riparian Conservation Areas
iv. Total acres of suitable habitat affected

v. Occupied areas affected
   1) Total acres of utilized habitat affected
   2) Total acres of unknown habitat affected
   3) Total acres of unutilized habitat affected

d. In the case of multiple projects submitted to the Service at a single time, the Forest Service will include a regional summary table for all nine National Forests with the following information on each of the three listed amphibians:

   i. Name of National Forest
   ii. Total National Forest Service acres on each of the National Forests
   iii. Total acres within the projects on each National Forest
   iv. Total project acres in Riparian Conservation Areas on each National Forest
   v. Total acres of suitable habitat affected on each National Forest
   vi. Total acres of occupied habitat affected on each National Forest
      1) Total acres of utilized habitat affected on each National Forest
      2) Total acres of unknown habitat affected on each National Forest
      3) Total acres of unutilized habitat affected on each National Forest

4. The Service will notify the Forest Service via electronic mail if the information on a project submitted for appendage to this programmatic biological opinion is inadequate for analysis. These appendages will be when individual project level take is provided.

5. The Forest Service will retain the original documents for each individual project in a secure location. The documents will be made available for review upon electronic mail request by the Service.

Definitions used in this Programmatic Biological Opinion

Habitat Definitions for the Three Listed Amphibians

The following definitions were developed by the Forest Service and the Service. "Suitable Habitat," and the sub-categories "Utilized," "Utilization Unknown," and "Unutilized Potential" for the mountain yellow-legged frog and the Yosemite toad are defined in this programmatic biological opinion. Each project will be specifically analyzed for the potential adverse effects on the three listed amphibians, as appropriate, when occurring in, or affecting suitable habitat. For a specific project, the analysis area may be modified based on local conditions that suggest a low probability of habitat being suitable. In these cases, reasons for this decision will be reviewed and approved by the Service.

1. *Suitable Habitat*

   a. Yosemite toad: Suitable breeding and rearing habitat includes wet portions of meadows, slow-moving streams, shallow ponds, spring systems, and lakes with shallow areas that are inundated at snowmelt and hold water for a minimum of 5 weeks in most years. Some sites containing suitable habitat may not retain water long enough for completion of metamorphosis in drought or below average precipitation years. Suitable habitat that is not used for breeding or development of early life history stages includes all portions of

meadows or other occupied breeding habitats and surrounding areas up to a distance of 0.78 mile depending on surrounding landscapes and dispersal barriers. In some cases, additional areas may be important for dispersal.

b. Mountain yellow-legged frog: Suitable habitat typically occurs above 4,500 feet in elevation, but in some areas, including the west side of the Plumas National Forest, it is thought to occur as low as 3,500 feet in elevation. Suitable habitat includes permanent water bodies or those hydrologically connected with permanent water such as wet meadows, lakes, streams, rivers, tarns, perennial creeks, permanent plunge pools within intermittent creeks, and pools, such as a body of impounded water contained above a natural dam. Suitable habitat includes adjacent areas, up to a distance of 82 feet. When water bodies occur within 984 feet of one another, as is typical of some high mountain lake habitat, suitable habitat for dispersal and movement includes the overland areas between lake shorelines. In mesic areas such as lake and meadow systems, the entire contiguous or proximate areas are suitable habitat for dispersal and foraging.

2. *Occupied or Utilized Habitat*: Suitable Habitat consists of one or a combination of "utilized habitat," "utilization unknown habitat," and/or "unutilized potential habitat". Previous surveys conducted by qualified biologists may be used, including surveys conducted by qualified non-Forest Service biologists. The Forest Service will provide biological data if Service-concurrence is being sought for non-protocol survey(s) results that conclude the action area is not occupied or utilized by one or more of the three listed amphibians.

For the initial batch of projects submitted under the BA in 2014, a period of 15 calendar years was used to determine if habitat is unutilized potential, and the criteria for consecutive surveys was relaxed. However, for all future projects that will be appended, a period of 10 calendar years will be used following the definition described below. Habitats may be considered to be utilized regardless of when prior surveys occurred.

a. *Utilized*: Suitable habitat that is used for breeding, development of early stages, resting, foraging, or dispersal. In streams, this includes the length of the stream for a distance of 0.62 mile upstream and 0.62 mile downstream of the location where species has been found.

b. *Utilization Unknown*: Suitable habitat where the species has not been observed and the area has not been determined to be unutilized potential based on the definition described below.

c. *Unutilized Potential*

i. Mountain yellow-legged frog: Suitable habitat where no individuals have been observed during at least three surveys within the previous 10 calendar years. The implementation of the three surveys will be either staggered during one summer with and early, mid, and late season survey (e.g. from 14 calendar days after sufficient habitat becomes free of snow at snowmelt to the fall before cold temperatures trigger movements to overwintering habitats, or conducted during three separate consecutive calendar years, that are ideally but do not have to be

consecutive. At least one of the surveys will be conducted during a water year where snowpack is 80 percent or greater than normal for the action area.

ii. Yosemite Toad: Suitable habitat where no individuals have been detected and the following survey conditions have been met:

1) At least one protocol survey will be completed each season for three consecutive years during the previous 10 years.
2) Surveys will be conducted during the period from approximately 21 days to 35 days after breeding pools form at snow melt, and at least one of the surveys will be conducted during a water year where snowpack is 80 percent or greater than normal for the area.

The determination of the type of habitat is based on existing available survey data collected within the last 10 years or new survey data collected for the project. For example, if the California Department of Fish and Wildlife, U.S. Forest Service, National Park Service, the Service, or the appropriate agency or party has surveyed 2 times within the previous 10 years with no frogs found, then only one addition survey needs to be conducted to determine whether habitat is in the unutilized potential category

Definitions of Forest Service Terms

1. *Best Management Practices* (BMPs): Highly specific mandatory measures used by the Forest Service to meet Department and Agency requirements and policies to ensure non-point source pollutants are controlled, legacy sources of water pollution are remediated, water quality is maintained or improved and the objectives of the Clean Water Act are met.

2. *Standard and Guidelines* (S&Gs): Highly specific mandatory measures to guide design and implementation of management action used by the Forest Service to meet Department and Agency requirements and policies.

2. *Critical Aquatic Refuges* (CARs): Map-delineated subwatersheds of generally 10,000 to 40,000 acres in size (range = 500 to 100,000 acres) in which specific goals and objectives for threatened, endangered and sensitive species as well as riparian-dependent resources are articulated. These designations encompass either known locations of threatened, endangered or sensitive species; vulnerable populations of plant or animal species; or local populations of rare aquatic-or riparian dependent plants or animals. These areas are specified on the project map(s) provided to the Service, and may also be found in Volume 4, Appendix I of the Sierra Nevada Framework Plan Amendment (SNFPA) FEIS (January 2001). S&Gs 91-124 of the SNFPA ROD (USFS 2004) apply to all CARs, RCAs and SMZs.

4. *Aquatic Management Strategy* (AMS): The overarching SNFPA Framework ROD strategy for management of aquatic, riparian, meadow ecosystems and associated species this strategy includes 6 riparian conservation objectives (SNFPA ROD, pages 33-34), a description of desired conditions a set of land allocations (RCAs, CARs, etc.) an adaptive management program and use of landscape analysis process to identify restoration and enhancement projects.

5. *Riparian Conservation Areas* (RCAs): Specifically defined buffers in which management activities are designed to meet specific goals and objectives for streams, special aquatic features, and other hydrological depressions. The width of the buffer varies as follows and may also be adjusted site-specifically to reflect the local topographic and hydrological conditions (S&Gs 91-122 from the SNFPA ROD and apply to all RCAs):

   a. *Perennial Streams*: 300 feet on each side of the stream, as measured from the bank full edge.

   b. *Seasonally Flowing Streams* (Intermittent and Ephemeral): 150 feet on each side of the stream, as measured from the bank full edge.

   c. *Stream Adjacent Slopes Greater Than 70 Percent Gradient*: top of the inner gorge or slope.

   d. *Lakes, Wet Meadows, Bogs, Fens, Wetlands, Vernal Pools and Springs*: 300 feet from the edge of the feature or riparian vegetation, whichever is greater.

6. *Streamside Management Zones (*SMZs*) and Riparian Management Zones (*RMAs*)*: these are broader terms intended to encompass other older naming conventions from streamside buffering areas such as CARs, RCAs, stream protections zones, riparian reserves, riparian habitat conservation areas, etc. All of these designated areas along riparian areas, streams, and wetlands that will minimize potential for adverse effects from adjacent management activities (refer to BMPs 1.8 and 1.19). Management activities within these zones are designed to improve riparian values. SMZs are areas other than or in addition to CARs or RCAs that are managed to standards specifically defined in individual Forest Land and Resource Management Plans. This designation typically results in conservation measures as specified in project batches.

7. *Range of Natural Variability* (RNV): The ecological conditions, plus the spatial and temporal variation in these conditions, that are relatively unaffected by people, within a period of time and geographical area appropriate to an expressed goal. A condition described as being "outside the RNV" implies specific pressure(s) on the system, usually anthropogenic in origin, moving it beyond the bounds of historical ecological variability.

8. *Project Manager*: A Forest Service employee with responsibility for designing, implementing, and/or administrating a particular project. This may include, but are not limited to, the following IDT leader, timber sale administrator, permit administrator, etc.

9. *Essential Habitat* This is a fisheries term used to denote those waters and substrates necessary to fish (or amphibians in this case) for spawning, breeding, feeding, or growth to maturity (Section 1910) of the MSFCMA, 16 USC § 1802(10)). For purposes of interpreting this definition of essential habitat: "Waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by the target species, and may include aquatic areas historically used where appropriate; "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities; "necessary" means the habitat required to support a sustainable fishery and managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle.

Description of the Nine Forest Programs

The BA contains a list and comprehensive description of nine Forest management activity programs. The nine programs are summarized below:

1. Vegetation Management, Timber Harvest, Fuels Management and Watershed Restoration: This program includes vegetation management conducted for ecological restoration, timber harvest, reforestation, fuels treatment for hazard reduction, fire or fuels treatment, forest health and range land improvement, watershed restoration, wildlife habitat enhancement, road construction, road reconstruction, and road maintenance and log landing construction, including temporary roads, using heavy equipment with either tracks or rubber tires. The most common means of treatment are mechanical, hand including chainsaws, chemical including pesticides (although pesticide use will not be covered in this consultation other than stump application of borax under various trade names such as Sporax), and burning.

   Timber harvest and fuels reduction includes marking, felling, bucking, skidding, yarding, loading by means of mechanical or hand treatments, and hauling designated trees to a mill. Mechanical methods include tracked feller-bunchers or harvesters used to harvest trees followed by skidding material, usually whole tree length, to landing using rubber-tired or tracked skidders. Conventional systems include hand felling and bucking trees followed by skidding material to landing using rubber-tired or tracked skidders. Endlining of felled material will be used when equipment is unable to directly reach felled trees. Water bars for erosion control on skid trails will be installed with either skidders or dozer. Harvest may be followed by reforestation, which includes preparation of the harvested site to treat excess fuels and competing vegetation by means of mechanical or hand piling and single or multiple chemical applications (not covered in this BO), followed by tree planting, and stand maintenance as needed. Other re-vegetation project areas may include trails, roads, prescribed and natural post-fire areas, facilities, and restoration sites. Salvage logging of dead and dying trees within burned acreages may also occur.

   Fuels management activities will be implemented to reduce the size, cost, and damage from wildfire as well as restore fire to the landscape as a natural disturbance process. Fuel biomass will be altered by changing the horizontal and vertical continuity of fuel type, creating fuel breaks, or by reducing or altering fuels over extensive areas by mechanical means as described in vegetation management, by the application of prescribed fire, or managing naturally ignited wildfires. Cull logs and slash may be rearranged, removed, or burned to reduce fuel loading. The silvicultural practices include mechanical, aerial, and/or hand treatments, prescribed fire, reforestation, and chemical application. Prescribed fire includes understory burning, pile burning, and broadcast burning by means of hand ignition using drip torches, or by aerial application using a helicopter mounted ignition devices such as helitorches for broadcast burning and spherical ignition devices for timber understory burning.

2. Maintenance of Roads and Trails: Road and trail maintenance, including reconstruction, is periodically implemented to ensure safe public use and protect resources. This program includes a number of activities.

   a. Motorized, Reconstruction or Maintenance of roads: For public use, and to administer and protect resources, roads will be periodically reconstructed and maintained. Some roads may

be constructed for specific recreation use, and some roads may need to be reconstructed over time to make needed improvements in alignment, grade, width and drainage.

Road maintenance includes any expenditure for the repair or upkeep of a road necessary to retain the road's approved traffic service level. Work items include surface blading, surface rock replacement, seal coats and asphalt overlays and patching, culvert cleaning, replacement or repair, bridge maintenance or replacement, slide removal, lead out ditching, road side ditch clean out, guardrail installation and replacement, road striping, and other items that contribute to the preservation of the existing road. Regular road maintenance also includes brushing (trimming of trees and shrubs) along the road prism to ensure that visibility for drivers is not hindered. These activities include installing additional minor culverts and traffic control devices, implementing traffic management strategies, placing small quantities of spot surfacing, re-vegetating cut and fill slopes, and blocking and/or disguising unauthorized routes originating on or crossing system routes. Some roads will be allowed to deteriorate gradually over time.

Where roads and trails are no longer needed or cannot be maintained, the Forest Service may remove them by decommissioning. This involves removal from maintenance schedules and from maps and, in some cases, may involve some on-site activities such as de-compaction of the roadbed, blocking, barricading, installation of water bars, removal of culverts, and re-contouring of slopes.

b. Maintenance of roads and trails for motorized non-street-legal vehicles: Maintenance of off-highway vehicle (OHV) routes consists of tread maintenance such as loose rock removal, rock and root removal, slough and berm removal, slide maintenance, and grooming of the tread surface; drainage maintenance such as maintenance of water bars, rolling dips, culverts, French drains and other water control/diversion devices; maintenance of water and gully crossings, route maintenance such as removal of fallen logs, brushing along trail prism, removal of hazard trees, litter removal, slope revegetation, snowmobile trail grooming, and closure/restoration of off-route impacts; structure maintenance such as barriers, barricades, retaining walls, trail tread protection measures, cattle guards, fences, and gates; and traffic services such as sign repair and installation. Maintenance work for roads and trails is done by means of mechanical and hand treatments and scheduled on an as needed basis.

   Grooming on specific over-snow vehicle (OSV) trails will be implemented during the winter months to provide recreational opportunities. General maintenance of these routes during the non-snow season consists of actions described under OHV maintenance.

c. Maintenance of non-motorized trails: The maintenance of non-motorized trails includes activities similar to OHV maintenance. Maintenance work on trails in wilderness areas is accomplished by means of primitive skills using non-motorized/mechanized traditional hand tools such as crosscut saws, axes, and shovels; blasting; crushing or moving rock; cutting and utilizing down logs; and rigging to move materials.

d. Hazard tree removal along roads and trails: Dead or dying trees and/or hazard trees within falling distance of roads and trails will be felled and/or removed for public safety. Harvest of hazard trees includes both mechanical and conventional harvest systems. After harvest, slash treatment will include hand/machine piling and pile burning adjacent to roads. Where

fuel loading is not an issue, slash may be lopped with chainsaw and scattered by hand. Created skid trails will have waterbars constructed along the length of the skid trail for erosion control.

3. Maintenance of developed recreation sites and administrative infrastructure: Recreation on National Forest lands includes a wide range of environmentally-sustainable developed and dispersed recreation opportunities in developed sites and dispersed areas such as trails, rivers or lakes, wilderness, and general forest areas.

   Developed recreation includes family and group campgrounds, day use picnic areas, trailheads, snow parks, visitor centers, visitor information sites, fire lookouts, corrals, boat ramps, pastures, and developed ski areas. Management of these facilities includes operation and maintenance/minor repair of internal site roads and buildings, trails, ski slopes, boundary fencing, picnic tables and fire rings, restrooms, water systems, dumpsters, regulatory signs and bulletin boards, barrier logs, camp host sites, concrete parking slabs, and interpretive panels in addition to administration of the site visitors.

   This program includes the routine maintenance of administrative facilities, and minor re-construction to replace or rehabilitate outdated facilities and associated infrastructure located on National Forest lands in the Sierra Nevada. Forest Service facilities include buildings, fire stations, work centers, permanent field camps, ranger stations, visitor centers, visitor information sites, public water systems, sanitation systems, camps, towers, pipelines, stream gauging stations, water storage and conveyance facilities, and other permanent or semi-permanent structures and infrastructure associated with Forest Service-administered facilities. Facilities on National Forests operated and maintained by the private sector through easements or special use authorizations including work and organizational camps, concession sites, ski areas, electronic and communication sites, public water and sanitation systems, power transmission lines, pipelines, research equipment and structures, and access routes to private land in-holdings. These third-party non-Forest Service administrative sites are generally administered or operated through special use permits.

   This program includes vegetation management of both native and non-native species such as routine felling and/or removal dead/dying trees and hazard trees within falling distance of administrative facilities for public safety; and fuels reduction activities cut smaller vegetation and the material is either chipped or piled and burned.

4. Special Use Permits: This program covers a variety of activities requiring permits that occur on National Forests in the Sierra Nevada. The activities include:

   a. Permitted activities: This includes pack station operations such as day rides, spot trips, dunnage drops and client camping in wilderness and non-wilderness areas using system and approved user trails, outfitting/guiding operations in wilderness and non-wilderness, river rafting, organization camps, and recreational residences.

   b. Permitted temporary activities: This includes the temporary use of National Forest lands for activities such as weddings, commercial filming and commercial still photography, training, commercial special events, vendors, and organized temporary events such as races, rides, regattas and festivals.

c. Facilities management: This includes vegetation management at facilities such as hazard tree felling, vegetation clearing, chipping and pile burning.

d. Communication sites: this broadcast radio and television, cable television, microwave for industrial and common carriers, cellular telephone, land-line telephone, and amateur and mobile radio transmission and repeater sites.

e. Transportation related activities: This include facilities such as avalanche control centers, maintenance yards, storage facilities, airport navigation beacons, helicopter landing sites, Department of Transportation easements, private party easements, and rights of way.

f. Utilities activities: This includes underground and overhead alignments for utilities including fiber optic, telephone, cable, water, sewer, gas and electricity transmission and distribution facilities, and specific sites for wells, water tanks, springs, dams, pump stations, fish ladders, water diversion, reservoirs, snow pillows, snow survey towers and cabins, and other utilities.

g. Community use and public information: This includes permitted land uses such as non-commercial group use, monuments, markers, signs, benches, interagency visitor centers, amphitheaters, museums, transit centers, and cultural centers.

h. Non-timber forest product associated activities: This includes commercial and non-commercial collection of materials such as firewood, plants, seeds, mushrooms, berries, biomass, pine cones, insects, extractives, Christmas trees, boughs and apiaries.

5. Rangeland Management: This program includes activities related to the development, administration, and protection of range resources, and includes the permitting and regulation of grazing use of all kinds and classes of livestock on National Forest lands in the Sierra Nevada. The animals are cattle, sheep, goats, horses, and saddle stock. A primary purpose of the rangeland management program is to provide forage for commercial livestock operations. Grazing also can be a means of managing vegetation to meet other resource management objectives, such as fuels management, invasive species management, wildlife habitat improvement, and reduction of competing vegetation in plantations.

   An allotment is a designated area of land capable and suitable for domestic livestock grazing. The Forest Service has an established process for grazing administration. Term grazing permits are generally issued for a period of 10 years, and authorize a permittee to graze livestock on their designated allotment(s).

   Grazing on an allotment is conducted in accordance with an Allotment Management Plan which is incorporated into the term grazing permit. National Forests develop and implement allotment management plans to ensure livestock use meets rangeland management objectives. Allotment Management Plans identify the grazing strategies needed to meet rangeland and other conservation objectives within the allotment. The Allotment Management Plan establishes grazing systems, stocking rates, kind and class of livestock, period of use, season of use, livestock distribution, and range improvements. It is implemented through Annual Operating

Instructions. Annual Operating Instructions include annual adjustments to management based on monitoring and site specific objectives, and are revised to reflect current project design criteria.

The activities associated with the range management program include livestock handling, moving, herding, gathering, salting, and other ordinary husbandry practices. Range management includes implementation and maintenance of structural and non-structural improvements to the allotments. Structural improvements are permanent features designed to facilitate livestock management and control distribution and movement of livestock, such as dams, impoundments, ponds, pipelines, fences, corrals, wells, and trails. Non-structural improvements include cutting, chaining, and planting.

6. Biological Resources Management: Activities that survey or monitor species, enhance, or restore their habitats are included in the Biological Resources Management Program. The primary restoration implemented for mountain yellow-legged frogs is the removal of nonnative fish species from lake habitats. This program also includes restoration, protection, maintenance, or improvement of habitats, such as stream and/or meadow restoration, planting, blocking/disguising unauthorized vehicle or trail routes, elimination of exotic weeds, fencing, and removal of trash.
7. Invasive Species Management: This program includes activities that detect, prevent, control, and eradicate invasive species. The activities may include, but are not limited to, surveys for the early detection of non-native plant and animal species in order to contain and control them; monitoring known occurrences including those that have been treated, and treating or re-treating occurrences; operation of inspection stations; manual removal; chemical and biological removal; thinning and fire; and outreach and education..

   Invasive plant control includes manual removal and the use of selected herbicides. Most of the activities involving removal of non-native plants involve little ground disturbance. Treatment activities include direct removal of weeds by hand; a "weed wrench" or by cutting with hand-tools or with a chainsaw for larger invasive shrubs; herbicides at administrative and developed sites, as well as other locations. Focused ground based application methods such as low volume foliar-spraying, cut and daub, basal bark, or frill methods of herbicide application may be used. Herbicides are not directly applied within any riparian or wetland areas and application follows U.S. Environmental Protection Agency (EPA) label instructions. This biological opinion, however, does not cover application of pesticides/herbicides other than stump application of borax under various trade names such as Sporax.

   This program includes the removal of non-native animals such as bullfrogs, and certain non-native fish. These activities generally do not result in ground disturbance but involve trapping, electro-shocking, or other techniques.

8. Mining: The mining program includes activities seeking and removing minerals under the general mining laws, leasable minerals under the mineral leasing laws, and common variety minerals which can be sold or leased. Under the mineral leasing laws, leases can be issued for energy development. In addition, mineral sales can authorize the extraction of common variety minerals such as sand, gravel or stone for landscaping or building. Mining on National Forest lands in the Sierra Nevada includes aggregate, placer, hardrock, hydraulic, and suction-dredge operations to the extent permitted by the State of California. The activities in this program

include exploration, experimental drilling, land surveys, site clearing, road construction and use, use of heavy equipment, water drafting, and the development and operation of mining camps. The Forest Service conducts reclamation of abandoned mines. Under the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA)(42 U.S.C. 9601 *et seq.*, as amended), the Forest Service responds directly to releases or threatened releases of hazardous substances from closed and abandoned hazardous waste sites that may endanger public health or the environment. This includes site re-grading and stabilization; removal of mining equipment, structures, and debris; revegetation; road reconstruction and removal; and abating safety hazards by removing hazardous substances and closing underground openings.

9. Lands (Real Estate): This program consists of the acquisition, development, and reclamation of lands and facilities located on National Forest lands in the Sierra Nevada. It includes surveys and marking of property boundaries typically involving one or two people with surveying equipment; boundaries marked with fence posts, tags nailed to trees, or buried aluminum pipe with information caps; and occasionally important corner posts or survey monuments must be set in the ground with concrete.

Project Monitoring

The Forest Service will develop and implement a monitoring plan to evaluate the success of Forest Service conservation measures in minimizing effects to the three amphibian species and their habitats from management activities identified by the Monitoring Team as important, such as livestock grazing, etc. The monitoring plan will be developed cooperatively with the Service, as well as other agencies and entities to the extent possible, and submitted to the Service for final review and approval by April 30, 2015.

There will be three components to the monitoring plan:

1. Compliance/Implementation: Determination of whether each project and associated activities followed the project description as described by the Forest Service. This will be annually reported to Service on a mutually agreed upon date.

2. Take: The project-specific and total amount and type of incidental take for each of the three listed amphibians will be annually reported to Service on a mutually agreed upon date.

3. Effectiveness: The Forest Service will collect and analyze data regarding the success of the conservation measures in mitigating and minimizing adverse effects on the three listed species, suitable habitat and the primary constituent elements of designated Critical Habitat.
    a. The findings will be utilized in an adaptive management process to modify the programmatic project description and conservation measures, as needed.
    b. For the Yosemite toad, the monitoring program will focus on the effects on meadow hydrology.

The design and implementation of the effectiveness of the monitoring plan will incorporate the following elements:

1. Scientifically sound
2. Statistically robust
3. Probabilistic
4. Unbiased
5. Developed by an interdisciplinary team with expertise in
   a. Ecology of the three montane amphibian species
   b. Monitoring design and statistical analysis
   c. Montane meadow ecology
   d. Hydrology
   e. Range ecology and management
   f. Vegetation ecology and management
6. Conducted at scale(s) appropriate to questions posed and inferences made.
7. Specific measures regarding sampling, reporting and analysis periodicity (e.g. when, where, how often?)
8. Of sufficient duration within forest planning horizons, generally 10-15 years, to appropriately address the questions posed and inferences made, including any questions related to incremental and slow changes.

Although the goal is to design, fund and implement a cooperative inter-agency monitoring strategy, the Forest Service will retain the responsibility for oversight, implementation, analysis and reporting. The initial year of effectiveness monitoring (field season 2015) will be conducted largely as a pilot and used to refine methods, process, protocols, and other components.

Programmatic Conservation Measures

The following conservation measures are intended to avoid, and minimize, the effects of projects in the nine Forest programs on the Sierra Nevada yellow-legged frog, the Northern Distinct Population Segment of the mountain yellow-legged frog, and Yosemite toad,. These measures are the appropriate S&Gs and BMPs from the individual Forest Land and Resource Management as amended by the 2004 Sierra Nevada Forest Plan Amendment (USFS 2004), and Region 5 Hydrologic Best Management Practices. These S&Gs and BMPs are treated as minimums. Site-specific application of each will be tailored to exact project landscapes, topography, geology, soils, etc. and result in greater specificity, thereby providing more stringent protections for the three listed amphibians and their habitat. Some S&Gs and BMPs are designed to be implemented for all of the nine Forest programs, while others are specific to a single program. The majority of the conservation measures are intended to protect the three listed species, wildlife, and/or sensitive habitats. In addition to the S&Gs and BMPs, at the project level the nine Forests implement additional "Design Criteria" that specify how these will be implemented to meet site-specific desired conditions, such as avoiding or minimizing ongoing impacts to known occurrences of the three amphibian species. The Forest Biologist will work with the project manager to develop any minor project specific adjustments. These specific Design Criteria actions will be included as part of the Batch Process for individual projects. They also will be documented in a written report submitted after project completion to the Service.

1. General Measures: The following S&Gs and BMPs establish general guidelines that will be implemented for all nine Forest Service programs. Site-specific implementation measures that comport with these guidelines will be described for individual projects as they are proposed:

a. Wheeled vehicles off designated routes, trails, and limited off-highway vehicle (OHV) use will be prohibited to reduce the risk of crushing, injuring, or disturbing individuals of the three listed amphibians (per S&G 69).

b. Within critical aquatic refuges, occupied habitats, or areas proposed as Critical Habitat, mitigation measures to avoid impacts to the 3 listed amphibians will be implemented for ground disturbing equipment to reduce the risk of killing individuals and adversely affecting their habitat (per S&G 109). The measures may include avoiding the activity all together.

c. Low ground pressure equipment, helicopters, over the snow logging, or other non-ground disturbing actions will be implemented when needed to achieve Riparian Conservation Objectives in the written opinion of the Forest Biologist in order to minimize impacts to riparian conservation areas when operating off of existing roads. The measures include minimizing construction of skid trails or roads for access into riparian conservation areas for fuel treatments, salvage harvest, or hazard tree removal (per S&G 113).

d. Prescribed fire treatments will be designed to minimize disturbance to ground cover and riparian vegetation in riparian conservation areas (per S&G 111). Further, no prescribed fires will be lit within riparian vegetation (per S&G 109).

e. The use of low velocity water pumps and screening devices for pumps (per S&G 110) will be utilized during drafting for project treatments to preventing mortality of eggs, tadpoles, juveniles, and adult frogs.

f. Pesticide application within riparian conservation areas, for example to control invasive species or promote reforestation, will be limited to situations where the application is consistent with riparian conservation objectives (per S&G 97). The applications will be designed to avoid adverse effects to individuals and aquatic habitats of the three amphibian species where application is within 500 feet of occupied sites (per S&G 98).

g. Fuels and other toxic materials will be stored outside of riparian conservation areas and critical aquatic refuges (per S&G 99) to limit the exposure of the three amphibian species to the toxic materials associated with vegetation management activities.

h. If management activities are proposed in a CAR or RCA, site-specific mitigation measures will be designed to (1) minimize risk of sediment entry into aquatic systems and (2) minimize impacts to habitat for aquatic- and riparian-dependent species (per S&G 92).

i. Mechanical ground-disturbing activities may occur within RCAs and CARs when the activity is consistent with riparian conservation objectives (per S&G 113). Potential adverse effects will be minimized by a requirement to utilize low ground pressure equipment, helicopters, over snow logging or other non-ground disturbing methodologies when operating off of existing roads. BMPs will be applied, and construction of new skid roads or trails into these areas minimized.

j. When a project results in riparian vegetation being outside the range of natural variability to an extent that the three listed amphibians and/or their habitats may be negatively affected,

design criteria will be incorporated to mitigate effects or restore to riparian vegetation to the natural range of variability during project implementation (per S&G 105).

k. Disturbance will be limited to 20 percent or less of streambanks and natural lake shorelines to reduce the impacts to cover in aquatic habitats (per S&G 103). This is measured as a percent of stream reach or lake/pond shoreline affected by management activities such as bank sloughing, chiseling, trampling, or other means of exposing bare soil or cutting plant roots.

l. In CARS or RCAs, proposed management activities will increase or decrease frequency and distribution of coarse woody debris so that they more closely match levels within the range of natural variability in order to sustain stream channel physical complexity and stability (per S&G 108).

m. Native vegetation cover will be enhanced by various techniques including planting, seeding, soil stabilization, after wildfires to reduce the effects on wildlife and their habitats (per S&G 112). Seeds or cuttings will be obtained from appropriate local native plant species.

n. Management activities will not adversely affect water temperatures required for local species, including the three amphibian species (per S&G 96).

o. For projects that could adversely affect streams to the extent that the three listed amphibians and/or their habitats may be negative affected, and the streams are already outside the range of natural variability, mitigation measures and short-term restoration actions will be implemented to prevent declines and/or improve conditions. Long-term restoration actions will be evaluated and implemented according to priority (per S&G 102), which includes adverse impacts to listed species.

p. Forests will prohibit or mitigate ground-disturbing activities that adversely affect hydrologic processes that maintain water flow, water quality, or water temperature critical to sustaining bog and fen ecosystems and plant species that depend on these ecosystems. During project analysis, forests will survey, map, and develop measures to protect bogs and fens from such activities as trampling by livestock, pack stock, humans, and wheeled vehicles (per S&G 118).

q. Culverts and stream crossings will not create barriers except for the benefit of the three Sierra Nevada amphibians. Water drafting sites will be located to avoid adverse effects to instream flows and depletion of pool habitat. Where possible, maintain and restore timing, variability and duration of floodplain inundation and water table elevation in meadows, wetlands, and other special aquatic features (per S&G 101).

r. Corrective actions will be implemented when needed to restore hydrologic connectivity of aquatic systems that are disrupted by roads (per S&G 100).

s. When permits, if any, are re-issued, measures to minimize sedimentation will be evaluated and included as necessary (per S&G 93).

t. Actions consistent with S&Gs and the desired conditions of aquatic habitats will be implemented after identifying and evaluating adverse effects of recreation-associated activities (per S&G 116).

u. When gathering of pack stock is necessary, such as an overnight pack stock trip, new facilities will be located outside of meadow and riparian conservation areas to reduce the risk of directly killing or injuring individuals and impacting these habitats (per S&G 119).

Program Specific Conservation Measures

1. The following S&Gs and BMPs will be specifically implemented for the **Timber Harvest, Vegetation Management, Fuels Management, and Watershed Restoration** Programs. These conservation measures will be included as part of the individual projects that can be appended to this programmatic biological opinion.

   a. Protection needs will be established with appropriate restrictions and mapped prior to commencement of operations (per BMP 1.4). This includes wetlands, meadows, lakes, springs, streamcourse protection zone widths, etc.

   b. A limited operating period may be established to ensure that negative impacts to resources may be avoided; contract provisions can also be used to close down operations during adverse operating conditions (per BMP 1.5)

   c. The size and shape of regeneration harvest units will be established to prevent erosion and sediment in order to protect fish, wildlife and other resource needs including the three listed amphibians (per BMP 1.7).

   d. An emergency response plan will be created and implemented to prevent contamination of waters from accidental spills of hazardous substances (per BMP 7.4).

   e. Water quality and hydrologic considerations as evaluated by a trained earth or water scientist will be incorporated into the timber sale planning process (per BMP 1.1).

   f. Fire and fuels management activities in the form of preventative, corrective and administrative measures include the use of prescribed fire or mechanical methods to achieve resource objectives to reduce flooding and erosion perturbations. This may be achieved by managing the frequency, intensity and extent of wildfire (per BMP6.1). Where operations disturb the soil, a vegetative ground cover will be established to prevent erosion and sedimentation (per BMP 1.15)

   g. Harvested or managed areas will be revegetated within five years to contain the minimum number, size and species composition specified in regional silvicultural guides for each forest type. This protects water quality by helping to stabilize soils, increasing ground cover and providing improved infiltration (per BMP 1.23).

   h. Soil erosion will be minimized to protect water quality via the stabilizing influence of vegetation foliage and root networks. Surface-disturbed areas will be revegetated with grass

or browse species between previously planted trees as needed for control of overland runoff and to meet wildlife needs (per BMP 5.4).

i. Forests will maintain desirable stream channel characteristics and watershed conditions to ensure favorable conditions of water quality and quantity and maintain habitat for three listed amphibians. In designing harvest units, size and distribution of natural structures, such as snag and down logs, will be considered to prevent erosion and sedimentation (per BMP 1.2).

j. High-erosion hazard areas will be identified pre-project to adjust treatment measures and prevent downstream water-quality degradation (per BMP 1.3).

k. Unstable lands will be protected by providing special treatment of these areas to avoid triggering mass slope failure with resultant erosion and sedimentation (per BMP 1.6).

l. Tractor logging will be avoided where the predicted, post-logging erosion hazard cannot be reduced to either "low" or "moderate." The careful control of skidding patterns will serve to avoid onsite and downstream channel instability, build-up of destructive runoff flows, and erosion in sensitive watershed areas such as meadows and Streamside Management Zones (per BMP 1.9; per BMP 1.10).

m. The soil mantle will be protected from excessive disturbance to maintain the integrity of the Streamside Management Zones and other sensitive watershed areas, and control erosion on cable corridors. Heavy machinery will not be used over the sale area to reduce the amount of soil disturbance. Erosion-control measures will be applied as necessary in cable corridors to control erosion and runoff (per BMP 1.11).

n. Locate new log landings or reuse old landings located in such a way as to avoid watershed impacts and associated water quality degradation. Landing locations will be selected that involve the least amount of excavation and the least erosion potential, and to the extent feasible are well outside of the Streamside Management Zone; near the ridges away from headwater swales in areas that will allow skidding without crossing channels; and avoid violating the Streamside Management Zone, or causing direct deposit of soil and debris to the stream. The Sale Administrator will work with the Forest Biologist and the IDT when considering landings that do not meet these criteria. Landings will be located where the least amount of skid roads will be required, and sidecast can be stabilized without entering drainages or affecting other sensitive areas. Landings will be positioned such that the skid road approach will be as nearly level as possible to promote safety, and protect the soil from erosion. The number of skid trails entering a landing will be kept to a minimum (per BMP 1.12).

o. The Forest Service will ensure that purchasers and their sub-contractors understand and adhere to water-quality BMP prescriptions formulated during the timber sale planning process to prevent and control erosion during timber sale operations. This will be accomplished by setting forth the purchaser's responsibilities in the timber sale contract, and holding the purchaser accountable for actions of their sub-contractor (per BMP 1.13).

p. Appropriate erosion and sedimentation protection for disturbed areas will be provided by spreading slash, mulch, wood chips, or, by agreement, some other treatment, on portions of tractor roads, skid trails, landings, cable corridors or temporary road fills (per BMP 1.14).

q. Erosion will be minimized by ensuring that constructed erosion-control structures are stabilized and working (per BMP 1.20)

r. The Forest Service's formal acceptance of erosion control work by the sale purchaser will be required to ensure the adequacy of required erosion-control work on timber sales (per BMP 1.21).

s. Water quality will be maintained or improved by protecting sensitive areas from degradation which likely would result from using mechanized equipment for slash disposal. Special slash treatment site preparation will be prescribed in sensitive areas (including areas with habitat for the three listed amphibians) to facilitate slash disposal without use of mechanized equipment (per BMP 1.22).

t. Use of mechanized equipment will be prohibited from sensitive areas in meadows, wetlands, Streamside Management Zones, and landslide areas (per BMP 1.22, per BMP 1.8, and per BMP 1.1).

u. For soil disturbing treatments other than timber harvest (cover by other BMPs), preventative measures will be implemented that decrease sediment production and stream turbidity resulting from management activities e.g., disking, seed drilling, windrowing, that mechanically treat slopes. Preventative measures that will limit surface-disturbance activities will be identified for each specific site based on the slope, infiltration rate, permeability, and water-holding capacity of the soil of the site. Examples of preventative measures include extra ground cover requirements and/or buffers of streams and/or riparian areas for mechanical treatment (per BMP 5.1).

v. During project planning, slope limitation will be established for tractor use to reduce gully and sheet erosion and associated sediment production. This is a preventive measure to limit excessive surface disturbance and prevent surface water from concentrating. This measure facilitates making allowances for proper drainage of disturbed areas by limiting tractor operation to slopes where corrective measures such as water bars can be effectively installed (per BMP 5.2).

w. Watersheds will be restored to repair degraded watershed conditions and improve water quality and soil stability. Watershed restoration is a corrective measure to improve ground cover density; improve infiltration; prevent excessive overland runoff and conserve the soil resource; stabilize stream banks and stream channels; improve soil productivity; reduce flood occurrence and flood damage; and improve overall watershed function (per BMP 7.1)

x. The designations of SMZs will minimize the potential for adverse effects from adjacent management activities. Management activities within these zones are designed to improve riparian values and to protect the three listed amphibians. The SMZ will be a zone of total exclusion of activity, or a zone of closely managed activity that acts as an effective filter and

absorptive zone for sediment; maintains shade; protects aquatic and terrestrial riparian habitats; protects channel and streambanks; and promotes floodplain stability (per BMP 1.8).

y. Damage to the ground cover, soil, and the hydrologic function of meadows will be avoided to protect meadows. Unless otherwise agreed, trees felled into meadows will be removed by end-lining, with slash removed, and the resulting disturbance will be repaired where necessary to protect vegetative cover, soil, and water quality (per BMP 1.18).

z. In order to protect streamcourses and aquatic areas where diversion of the stream has resulted from timber management, unobstructed passage of stormflows will be provided, sediment and other pollutants entering streamcourses controlled, and the natural course of any stream restored as soon as practicable (per BMP 1.19).

aa. Tractor operations will be limited in wetlands and meadows. In order to limit turbidity and sediment production resulting from compaction, rutting, runoff concentration, and subsequent erosion use of mechanical equipment will be excluded in wetland and meadows except for the purpose of restoring wetland and meadow functions. Sediment and other pollutants will be controlled from entering streamcourses. The application of this BMP will be mandatory on all vegetation-manipulation projects as prescribed in the environmental documentation (per BMP 5.3). Specific protection measures will be established for each area that could incur adverse water-quality impacts (per BMP 1.18).

bb. Water-quality will be protected during the implementation of prescribed fires. The prescription will include at the watershed- and subwatershed-scale, the optimum and maximum burn block size, aggregate burned area, acceptable disturbance for contiguous and aggregate length for the Riparian/Streamside Management Zones; and expected fire return intervals and maximum expected area covered by water-repellant soils. (per BMP 6.2)

cc. Water quality will be protected from prescribed burning effects by maintaining soil productivity; minimizing erosion; and minimizing ash, sediment, nutrients, and debris from entering water bodies (per BMP 6.3). Some of the techniques that will be used to prevent water-quality degradation include constructing water bars in fire lines, reducing fuel loading in drainage channels; and maintaining the integrity of the Streamside Management Zone within the limits of the burn plan.

dd. Where possible, any long- and short-term adverse impacts to water quality associated with the occupancy and modification of floodplains will be avoided. Factors that will be evaluated include, environmental quality, ecological effects, and individual safety and health will be considered as well as flood frequencies, watershed conditions, climatic and environmental factors associated with past flood events, flood flow quantities and specific flood boundaries (per BMP 7.2).

ee. Adverse water-quality impacts associated with destruction, disturbance, or modification of wetlands will be avoided (per BMP 7.3). Factors that will be evaluated include, but are not limited to, water supply, water quality, recharge areas, functioning of the wetland during flood and storm events, flora and fauna, habitat diversity and stability, and hydrologic function of riparian areas.

ff. A water quality monitoring plan will be part of an environmental document, a management plan, or a special use permit, or it will be developed in response to other needs to evaluate the implementation and effectiveness of a management prescription in protecting water quality (per BMP 7.6).

gg. Management by closure to seasonal, temporary, and permanent use will be used to exclude activities that could result in damages to either resources or improvements, including impaired water quality from roads and trails (per BMP 7.7). Closure to use will occur when the condition of the watershed must be protected to preclude adverse water-quality effects and adverse impacts to the three listed amphibians (per BMP 1.5; per BMP 2.9).

hh. For any new proposed action or activity that may affect water quality, the Forest Service will examine all past, present, and future activities in a sub-watershed that may have a cumulative effect to water quality and beneficial uses (uses specified in water quality standards for each water body or segment), including the three listed amphibians if present in the sub-watershed or downstream. This Cumulative Watershed Effects (CWE) analysis is guided by considerations such as: whether the proposed activity along with other activity in that sub watershed exceed thresholds and are the risks to water quality are too great; whether the action can be deferred to let the watershed recover before implementation; and whether the short-term risks are acceptable, with added mitigation, given the long-term benefits (e.g., mechanical treatment of fuels may cause some short-term risk to water quality which may be acceptable if the treatment can prevent the greater impacts of a future large, high severity wildfire). The CWE process greatly facilitates development of appropriate mitigation measures/design criteria to avoid adverse effects to the three listed amphibians (per BMP 7.8).

2. The following S&Gs and BMPs will be specifically implemented for the **Road and Trail Maintenance** Program. These conservation measures will be included as part of the individual projects that can be appended to this programmatic biological opinion.

   a. To protect hydrologic values and aquatic species water source development and utilization will follow specific criteria for the location of drafting sites, procedures for drafting operations, as well as approaches and drafting pads (per BMP 2.5).

   b. The Forest Service will minimize water, aquatic, and riparian resource disturbances that may affect individuals of the three amphibian species and related sediment production when constructing, reconstructing, or maintaining temporary and permanent water crossings (BMP 2.8). Specifications for stream crossing areas and design, construction/reconstruction of permanent and temporary crossings, as well as maintenance of these crossings included in 36 technical specifications listed in BMP 2.8 will be followed.

   c. Measures described in BMP 2.11 to prevent adverse effects from fuels, lubricants, cleaners, and other harmful materials that are discharged into nearby surface waters or infiltrate through soils to contaminate groundwater resources on skin-respiring amphibians resulting from equipment refueling and servicing will be implemented.

d. To protect water quality during road maintenance and operations, 31 practices related to road inspection, maintenance planning, and operations will be implemented as appropriate based on local site conditions (per BMP 2.4).

e. Erosion, sedimentation, and chemical pollution that may result from snow removal and storage activities will be prevented or reduced (per BMP 2.9).

f. Road construction and reconstruction will be designed to minimize erosion and sediment delivery (per BMP 2.3).

g. Roads placed in storage will be maintained so that drainage facilities and runoff patterns function properly, and damage to adjacent resources is prevented (per BMP 2.6).

h. A project-specific erosion control plan will be developed to effectively limit and mitigate erosion and sedimentation from any ground-disturbing activities, through planning prior to commencement of project activity, and through project management and administration during project implementation (per BMP 2.13).

i. Adverse effects from roads after wildfires will be minimized to reduce erosion and resulting sedimentation (per S&G 112).

j. The effects to riparian and aquatic resources of creating, maintaining and using routes and areas for motorized off-highway vehicles (OHV) will be mitigated by OHV-specific BMPs designed for each individual project or batch.

k. OHV trails will be located to reduce the risk that sediment originating from designated trails and areas will enter watercourses and water bodies to minimize hydrologic connectivity, and by incorporating drainage structures into trail design to disperse concentrated runoff (per BMP 4.7.2).

l. The discharge of sediment into water bodies from OHV use will be minimized or prevented by implementing the appropriate techniques outlined in BMP 4.7.3 for crossing location, trail approaches to watercourses, and design and construction of watercourse crossings.

m. The discharge of sediment into water bodies will be minimized or prevented during construction, reconstruction, and realignment of OHV trails (per BMP 4.7.4).

n. OHV trails will be monitored to reduce the risk of sediment delivery to water, aquatic, and riparian resources by identifying watercourse crossings and OHV trail segments in need of maintenance, setting priorities for maintenance, and identifying OHV areas and trails that require closure and restoration (per BMP 4.7.5).

o. OHV trails will be maintained and operated to prevent or minimize discharges of sediment into watercourses and water bodies by maintaining OHV trails and associated drainage structures (per BMP 4.7.6).

p. The discharge of sediment into watercourses and water bodies will be minimized or prevented by permanently restoring OHV-damaged areas, watercourse crossings, and OHV trails no longer designated for use (per BMP 4.7.8).

q. The effects to aquatic organisms resulting from the discharge of sediment, petroleum, and chemical products, or human waste into water bodies and the contamination of groundwater by infiltration through soils will be minimized or prevented by planning, constructing, installing and maintaining drainage and runoff treatments at OHV staging areas, and by managing the risk of pollution at high-use and high-risk OHV areas (per BMP 4.7.9).

3. The following S&Gs and BMPs will be specifically implemented for the **Developed Recreation and Forest Service Infrastructure** Program. These conservation measures will be included as part of the individual projects that are submitted for appendage to this programmatic biological opinion.

   a. The measures that will be taken to ensure safe drinking water supplies for humans (per BMP 4.2) also benefit aquatic species. The guidelines for water source location and development; testing frequency and maximum contaminant levels for bacteriological, chemical, and physical contaminants; performance of sanitary surveys; closing, correction, and reopening of defective water systems; and documentation of data are part of the EPA Drinking Water Standards, and State and local health department standards.

   b. Proper sanitation and water supply facilities are required for organizational camps (per BMP 4.6), including protection of the quality of water that is consumed by and discharged from them under special use permit.

   c. Water quality within developed and dispersed recreation areas will be protected through the regulation of the discharge and disposal of potential pollutants (per BMP 4.9). This practice prohibits placing in, or near a stream, lake, or other water body, substances, which may degrade water quality. It includes, but is not limited to, human and animal waste, petroleum products, other hazardous substances, and sediment eroded from the site.

   d. The following measures may apply to the development of new or improvement of recreational sites depending on site-specific attributes:
      i. Measures during the construction of roads should protect streamflows, and avoid disturbance and impacts to the hydrology of wetlands and meadows where species or habitat may be present (per S&G 70). Specific projects will include the design criteria to minimize the risk of activity-related sediment entering aquatic habitats (per S&G 92).

4. The following S&Gs and BMPs will be specifically implemented for the **Special Use Permit** Program. The following conservation measures will be included as part of the individual projects that are submitted for appendage to this programmatic biological opinion.

   a. Degradation of water quality from pack, riding stock facilities, and heavy-use areas, locate pack and riding stock facilities to locations away from springs, streams, lakes, wet meadows, and other surface waters where pollution is likely to occur will be avoided. This includes large camp sites and trails repeatedly used by customers of commercial stock operators and other recreational uses (per BMP 4.10).

b. Impacts of activities under special use permits, protect surface and subsurface water quality from physical, chemical, and biological pollutants resulting from activities that are under a special use permit will be minimized. The terms of the special use permit will include details of the conditions that must be met, including management requirements and mitigation measures necessary to protect water quality. The permittee will be required to conform to all applicable State and local regulations governing water quality and sanitation (per BMP 7.5).

c. Ground-disturbing activities that adversely affect hydrologic processes that maintain water flow, water quality, or water temperature critical to sustaining bog and fen ecosystems and plant species that depend on these ecosystems will be prohibited or mitigated (per S&G 118). During project analysis, the USFS will survey, map, and develop measures to protect bogs and fens from such activities as trampling by livestock, pack stock, humans, and wheeled vehicles. Criteria for defining bogs and fens include, but are not limited to, presence of: (1) sphagnum moss, (2) mosses belonging to the genus *Meessia*, and (3) sundew. Updates to criteria defining bogs and fens will be applied as appropriate.

5. The following S&Gs and BMPs will be specifically implemented for the **Rangeland Management** Program. These conservation measures will be included as part of the individual projects that are submitted for appendage to this programmatic biological opinion.

a. The allotment management planning process is used to develop measures to avoid, minimize, mitigate and/or restore adverse impacts to water and aquatic and riparian resources during rangeland management activities including the three listed amphibians (per BMP 8.1). The process includes design criteria such as direction to establish annual endpoint indicators of use related to the desired conditions and triggers or thresholds for management actions, including modification of livestock intensity; frequency, duration and timing of livestock use such as better distribution of stock; change in animal months and/or season of use; and livestock exclusion. The indicator thresholds are set at levels that protect or improve condition of riparian areas and aquatic ecosystems.

b. Assess the hydrologic function of meadow habitats and other special aquatic features during range management analysis. Ensure that characteristics of special features are, at a minimum, at Proper Functioning Condition, as defined in the appropriate and current Technical Reports or their successor publications (per S&G 117).

c. Livestock utilization of grass and grass-like plants will be limited to 30 percent in early seral stage meadows and 40 percent in late seral stage meadows to minimize the impact of livestock grazing to the hydrology of meadow habitats under season-long grazing (per S&G 120). Meadow ecological status will be evaluated every 3 to 5 years and livestock grazing will be modified or suspended if the status is determined to be moving in a downward trend. Under intensive grazing systems where meadows are receiving a period of rest, these standards may be higher. Degraded meadows, such as those in early seral status with greater than 10 percent of the meadow area in bare soil and active erosion, will require total rest from grazing until they have recovered and have moved to mid- or late seral status.

d. Browsing will be limited to no more than 20 percent of the annual leader growth of mature riparian shrubs and no more than 20 percent of individual seedlings (per S&G 121).

Livestock will be removed from areas when browsing indicates a change in livestock preference from grazing herbaceous vegetation to browsing woody riparian vegetation.

e. Rangeland improvement techniques for application will be designed to implement range improvements to protect, maintain or improve water and aquatic and riparian resources and associated beneficial uses (per BMP 8.3). Rangeland improvements targeted at water and aquatic and riparian resources will be designed to protect or improve conditions of sensitive areas such as streams, riparian areas, and wetlands or upland areas in danger of crossing a threshold to a less desirable condition and move these resources toward desired conditions.

   i. The risk of direct effects to the eggs, tadpoles, and adults of the Yosemite toad during its breeding and rearing season will be reduced by either (a) excluding livestock from occupied standing water and saturated soils in wet meadows and associated streams and springs or areas identified as "essential habitat" (per S&G 53) or (b) developing and implementing a site-specific management and monitoring plan to manage the movement of stock around occupied wet areas (per S&G 54).

f. Range permit administration includes the following specific measures to manage rangeland vegetation and grazing to protect water and aquatic and riparian resources (as detailed in BMP 8.2):

   i. Monitoring:

      1) Field checks and measurements will be made at least annually as described below by Forest Service or permittee with quality control provided by the Forest Service.

      2) Monitoring will be emphasized to determines permittee compliance with permit provisions. The compliance indicators for annual use include those related to water quality, forage utilization, streambank alteration, or utilization of woody riparian vegetation with specific information regarding the status of the three listed amphibians.

      3) Monitoring will be used as an adaptive management feedback loop to revise the Annual Operating Instructions to account for current allotment conditions and trends and the status of the three listed amphibians.

      4) There will be monitoring to determine management effectiveness and trends that affect water quality, as well as habitat or other beneficial uses as necessary, including 303 listed streams and the three listed amphibians.

   ii. Livestock Number and Distribution

      1) The results of annual compliance monitoring and periodic trend monitoring, as well as forage utilization by wildlife and the status of the three listed amphibians, will be utilized to determine the allowable annual amount of livestock use to meet rangeland desired conditions.

2) The allowable use, planned sequence of grazing on the allotment, and any other operational changes in the Annual Operating Instructions issued to the permittee each year will be documented.

3) Livestock distribution will be altered when monitoring and periodic assessments indicate consistent non-compliance with permit provisions.

4) Livestock use will be managed through control of time/timing, intensity, and duration/frequency of use in riparian areas and wetlands to maintain or improve long-term functional stream condition, and allow for riparian hardwood growth extension and/or other stabilizers, such as herbaceous plants, and reproduction where the riparian plant community is below its desired condition and livestock are a key contributing factor.

5) Livestock will be managed to prevent further degradation of riparian areas and wetlands that are not meeting or trending toward desired condition objectives.

6) Livestock will be excluded if monitoring information shows continued livestock grazing would prevent attainment of those objectives.

7) Stock tanks, salt supplements, and similar features will be located to distribute cattle evenly over the allotment and prevent concentrations of cattle in Streamside Management Zones and wetlands.

8) Stock driveways will be kept out of riparian areas except to cross at designated points.

9) Triggers will be established for livestock trampling and riparian vegetation utilization on or immediately adjacent to stream banks for timing livestock moves between units.

10) Livestock herds will be managed to avoid concentrating in riparian areas and wetlands during the hot season, e.g. mid-to-late summer.

iii. Season of Use:

1) Livestock numbers and/or season of use will be adjusted when monitoring and periodic assessments show consistent non-compliance with permit provisions.
2) Livestock will be managed to avoid grazing through an entire growing season in pastures that contain riparian areas and wetlands.

3) Short-duration grazing as practicable, generally less than 20 days, will be applied to minimize re-grazing of individual plants, to provide greater opportunity for regrowth, and to manage utilization of woody species and reduce soil compaction.

iv. Permit Administration:

1) Permit authorities will be used to change operations to protect water and aquatic and riparian resources when special circumstances, such as when a drought occurs

2) Corrective actions will be taken if monitoring and periodic assessments show consistent non-compliance with permit provisions. The actions may include:

a) Adjust livestock numbers and/or season of use

b) Alter livestock distribution

c) Install fences and water developments.

d) Place the allotment or unit of concern in rest or non-use status for a period of time that allows for natural recovery of resource condition where the potential exists.

3) Suspension and cancellation guidelines will be applied in cases of intentional noncompliance with the terms and conditions of the permit.

4) Permits will be modified, cancelled, or suspended in whole or in part, as needed, where it is determined to be necessary to ensure proper use of the rangeland resource and protection of other resources, such as water quality.

6. The S&Gs, and BMPs listed in the general Forest Service management section above will be specifically implemented for the **Biological Resource Management**. These conservation measures will be included as part of any individual projects that are submitted for appendage to this programmatic biological opinion

7. The S&Gs, and BMPs listed in the general Forest Service management section above will be specifically implemented for the **Invasive Species Management**. These conservation measures will be included as part of the individual projects that will be submitted for appendage to this programmatic biological opinion.

8. The following S&Gs and BMPs will be specifically implemented for **Mining**. These conservation measures will be included as part of the individual projects that are submitted for appendage to this programmatic biological opinion.

a. Determine which critical aquatic refuges or areas within critical aquatic refuges are suitable for mineral withdrawal to protect the three listed amphibians. Propose these areas for withdrawal from location and entry under U.S. mining laws, subject to valid existing rights, for a term of 20 years after which reevaluation will occur (per S&G 123). It is stipulated that the Forest Service only has the authority to recommend mineral withdrawal. The Bureau of Land Management conducts the NEPA analysis and makes final decision regarding withdrawals from mineral entry.

b. Effects to hydrology will be reduced by the reclamation of mines, facilitated by S&G 64 which addresses the costs of various reclamation actions.

c. Mine owners and operators must limit new road construction, decommission unnecessary roads, and follow Forest Service road maintenance policy and direction (per S&G 65). This should minimize the risk of road-related effects to the hydrology of aquatic habitats associated with mining.

d. Design criteria that maintain or improve the hydrology of aquatic habitats will be included in mining-related plans of operation (per S&G 124).

e. There are specific processes to protect water quality from degradation by physical and chemical constituents resulting from locatable mineral operations, including exploration, development, production, and associated activities, on National Forest System lands. All mineral operations and associated activities must be conducted in an environmentally sound manner and in compliance with applicable Federal and State water quality standards and requirements, the operator must reclaim the National Forest Service lands disturbed by the mineral operations and associated activities by taking measures to restore, prevent or control damage including, but not limited to, control of erosion, landslides, and water runoff (per BMP 3.1).

f. Regular inspection and monitoring of mining-related activities will ensure compliance with laws, regulations, and operating plans (per S&G 67).

g. Forest Service guidelines for administering common variety mineral removal permits will ensure that resource values, including water quality, are protected to the maximum extent possible (per BMP 3.3). Permits and mineral material sale contracts will include reasonable erosion control measures, reclamation of the surface to a predetermined productive second use of the land, and revegetation.

h. Clearing of vegetation to the minimum necessary should minimize effects to vegetation cover (per S&G 68).

9. The S&Gs and BMPs listed in the general Forest Service management section will be specifically implemented for the **Lands and Real Estate** Program. Any project-specific additional measures will be included as part of the individual projects that are submitted for appendage to this programmatic biological opinion.

   a. Land surveys and marking property boundaries will generally involve one or two people on foot using specialized equipment to measure and delineate property boundaries.

Analytical Framework for the Jeopardy Analysis

The following analysis relies on four components to support the jeopardy determination for the Yosemite toad, Sierra Nevada yellow-legged frog, and Northern Distinct Population Segment of the mountain yellow frog: (1) the **Status of the Species**, which evaluates the species' range wide condition, the factors responsible for that condition, and their survival and recovery needs; (2) the **Environmental Baseline**, which evaluates the condition of these species in the action area, the

factors responsible for that condition, and the role of the action area in the species' survival and recovery; (3) the **Effects of the Action**, which determines the direct and indirect effects of the proposed programmatic Federal action and the effects of any interrelated or interdependent activities on these species; and (4) **Cumulative Effects**, which evaluates the effects of future, non-Federal activities in the action area on these three species.

In accordance with the implementing regulations for Section 7 and Service policy, the jeopardy determination is made in the following manner: the effects of the proposed programmatic Federal action are evaluated in the context of the aggregate effects of all factors that have contributed to the current status of the Yosemite toad, Sierra Nevada yellow-legged frog, and Northern Distinct Population Segment of the mountain yellow frog. Additionally, for non-Federal activities in the action area, we will evaluate those actions likely to affect these species in the future, to determine if implementation of the proposed programmatic action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of them in the wild.

The following analysis places an emphasis on using the range-wide survival and recovery needs of the Yosemite toad, Sierra Nevada yellow-legged frog, and Northern Distinct Population Segment of the mountain yellow frog, and the role of the action area in providing for those needs as the context for evaluating the significance of the effects of the proposed programmatic Federal action, taken together with cumulative effects, for purposes of making the jeopardy determination.

Action Area

The action area is defined in 50 CFR § 402.02, as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." For the proposed programmatic action, the action area includes all suitable and three utilized habitat categories (definitions below) in the nine National Forests for the Yosemite toad, Sierra Nevada yellow-legged frog, and Northern Distinct Population Segment of the mountain yellow frog subject to the programmatic effects of the nine Forest programs, including indirect and cumulative effects.

Status of the Species and Environmental Baseline

<u>Sierra Nevada Yellow-legged Frog and Northern Distinct Population Segment of the Mountain Yellow-legged Frog</u>

The Sierra Nevada yellow-legged frog and the Northern Distinct Population Segment of the mountain yellow-legged frog were both listed as endangered species on April 29, 2014, under the Endangered Species Act of 1973, as amended (Service 2014).

The mountain yellow-legged frog was originally described as a subspecies of the foothill yellow-legged frog (*Rana boylii*). Populations in the Sierra Nevada were considered to be subspecies *sierrae*, and populations inhabiting three mountain ranges in southern California were thought to represent subspecies *muscosa*. Later analysis of additional morphological data indicated what was considered *R. boylii sierrae* and *R. boylii muscosa* were instead more likely to be subspecies of *Rana muscosa* (Zweifel 1955). Later, Macey *et al.* (2001) conducted a phylogenetic analysis of mitochondrial deoxyribonucleic acid (DNA) sequences of the mountain yellow-legged frog and concluded the species consisted of two major genetic lineages comprised of three distinct groups in the Sierra Nevada, and a fourth distinct group in the mountains of southern California.

Based on mitochondrial DNA, morphological information, and acoustic studies, Vredenburg *et al.* (2007) concluded the mountain yellow-legged frog in the Sierra Nevada consists of two distinct species - *Rana muscosa* and *R. sierrae*. *R. sierrae*, or the Sierra Nevada yellow-legged frog, is endemic to the northern and central Sierra Nevada and adjacent Nevada ranging from north of the Feather River including the Plumas and southern edge of the Lassen National Forests, south to the Monarch Divide on the west side of the Sierra Nevada crest in the Sierra National Forest, and near Independence Creek on the east side of the Sierra Nevada crest in the Inyo National Forest. In the Sierra Nevada, *R. muscosa* ranges from the Monarch Divide south to Dunlap and Taylor meadows in the Sequoia National Forest (California Department of Fish and Wildlife 2011; Vredenburg *et al.* 2007). *R. muscosa* also occurs as a Distinct Population Segment in the Transverse and Peninsular Ranges in southern California, where it is listed as an endangered species. In the Sierra Nevada, the taxon ranges in elevation from approximately 4,500 feet to more than 12,000 feet (Vredenburg *et al.* 2005). However, the distribution of the Northern Distinct Population Segment of the Mountain yellow-legged frog appears to extend below 4,500 feet in elevation at higher latitudes; for example, on the Plumas National Forest (USFS 2014). Eight-percent of the observations on the Plumas National Forest are below 4,500 feet elevation; of which, thirty-one of the observations were between 3,500 and 4,500 feet in elevation.

Physical Description

The body length (snout to vent) of the adult mountain yellow-legged frog ranges from 1.5 to 3.25 inches (Dodd 2013b; Stebbins and McGinnis 2012; Lanoo 2005; Green *et al.* 2014; Jennings and Hayes 1994; Vredenburg *et al.* 2005; Wright and Wright 1949; Stebbins 1951; Zweifel 1955). Females average larger than males, and males have a swollen, darkened thumb base. Dorsal (upper) coloration in adults is variable, exhibiting a mix of brown and yellow, but also gray, red, or green-brown, and usually a pattern of dark spots. These spots may be large (0.25 inch) with a few, smaller and more numerous spots, or a mixture of both. Irregular lichen- or moss-like patches may also be present on the dorsal surface. The belly and undersurfaces of the hind limbs of the mountain yellow-legged frog are yellow or orange colored, and this pigmentation may extend forward from the abdomen to the forelimbs. The adults may produce a distinctive mink or garlic-like odor when disturbed (Wright and Wright 1949; Stebbins 2003). Although these two species lack vocal sacs, they can vocalize in or out of water, producing what has been described as a flat clicking sound (Zweifel 1955; Stebbins 2003). Mountain yellow-legged frogs have smoother skin, generally with heavier spotting and mottling dorsally, darker toe tips (Zweifel 1955), and more opaque ventral coloration (Stebbins 2003) than the foothill yellow-legged frog, which is a conspecific species in some portions of the Sierra Nevada.

The Sierra Nevada yellow-legged frog and the Northern Distinct Population Segment of the mountain yellow-legged frog can be distinguished from each other physically by the ratio of the lower leg (fibulotibia) length to snout vent length (Vredenburg *et al.* 2007). Typically, this ratio is greater than or equal to 0.55 for the northern Distinct Population Segment of the mountain yellow-legged frog and less than 0.55 for the Sierra Nevada yellow-legged frog. In addition, adult Northern Distinct Population Segment of the mountain yellow-legged frog generally has longer limbs than Sierra Nevada yellow-legged frogs.

Mountain yellow-legged frogs deposit their eggs in globular clumps, which are often somewhat flattened and roughly 1 to 2 inches in diameter (Stebbins 2003; Lannoo 2005; Vredenburg *et al.* 2005). When the eggs are close to hatching, egg mass volume averages 78 cubic inches (Pope 1999).

An egg has three firm, jelly-like, transparent envelopes surrounding a grey-tan or black vitelline capsule or egg yolk (Wright and Wright 1949). The clutch size varies from 15 to 350 eggs per egg mass (Livezey and Wright 1945; Vredenburg *et al.* 2005). The development of the egg is temperature dependent. In laboratory breeding experiments, eggs took from 18 to 21 days at temperatures of 41 to 56 degrees Fahrenheit to hatch after being laid (Zweifel 1955).

Mountain yellow-legged frog tadpoles generally are mottled brown on the dorsal side with a faintly yellow venter or underside (Zweifel 1955; Stebbins 2003; Vredenburg *et al.* 2005). Their total length may reach a maximum of 2.8 inches, the body is flattened, and the tail musculature is wide at 1 inch or more before tapering into a rounded tip (Wright and Wright 1949). The mouth has a maximum of eight labial tooth rows (Stebbins 2003).

Current Range and Distribution

Since the mountain yellow-legged frog observations made by Grinnell and Storer (1924), a number of researchers have reported disappearances of these two listed amphibian species from significant portions of their historical ranges in the Sierra Nevada (Hayes and Jennings 1986; Bradford 1989; Bradford *et al.* 1994; Jennings and Hayes 1994; Stebbins and Cohen 1995; Drost and Fellers 1996; Knapp and Matthews 2000a; Vredenburg *et al.* 2005; Martin 1992; Heller 1960; Jenkins 1994).

The current distribution of the mountain yellow-legged frog is primarily restricted to publicly managed lands within National Forests and National Parks at high elevations in the Sierra Nevada. National Forests with extant populations include the Plumas National Forest, Lassen National Forest, Tahoe National Forest, Humboldt-Toiyabe National Forest, Lake Tahoe Basin Management Unit, Eldorado National Forest, Stanislaus National Forest, Sierra National Forest, Sequoia National Forest, and Inyo National Forest. National Parks with extant populations of mountain yellow-legged frogs include Yosemite National Park, and Sequoia and Kings Canyon National Parks. Suitable habitat within the 9 Forests in the Sierra Nevada is indicated in Figures 1 and 2.

According to the Biological Assessment, the number of known occupied sites, such as lakes, ponds, meadows, and streams, are estimated to be around 1,245 sites for the Sierra Nevada mountain yellow-legged frog and 12 sites for the Northern Distinct Population Segment of the mountain yellow-legged frog. Eighty-one percent of the Sierra Nevada yellow-legged frog's range, and 51 percent of the Northern Distinct Population Segment of the mountain yellow-legged frog's range occur on Forest Service lands (California Department of Fish and Wildlife 2014a, 2014b). There are important caveats to these estimates of the number of occupied sites. First, in some cases multiple observations may have been counted for a specific site. Second, not all aquatic habitats have been surveyed, and given the complexity of aquatic habitats, definitions of sites vary among scientists and land managers. Third, more surveys for these species have occurred in lake habitats. Than in other habitats. Finally, these numbers do not necessarily represent populations; a single population may occupy multiple sites.

Habitat and Life History

The mountain yellow-legged frog currently and historically inhabited lakes, ponds, marshes, tarns, meadows, and streams, largely in areas that were glaciated during the Pleistocene at elevations ranging from 4,500 feet to 12,000 feet (California Department of Fish and Wildlife 2014a, 2014b; Zweitel 1955). The two listed amphibian species are highly aquatic (Stebbins 1951; Mullally and

Cunningham 1956; Bradford *et al.* 1993). Adults typically are found sitting on rocks along the shoreline, usually where there is little or no vegetation (Mullally and Cunningham 1956). Although

Figure 1. Mountain Yellow-Legged Frog (*Rana sierra and R. muscosa* northern DPS) Range Map

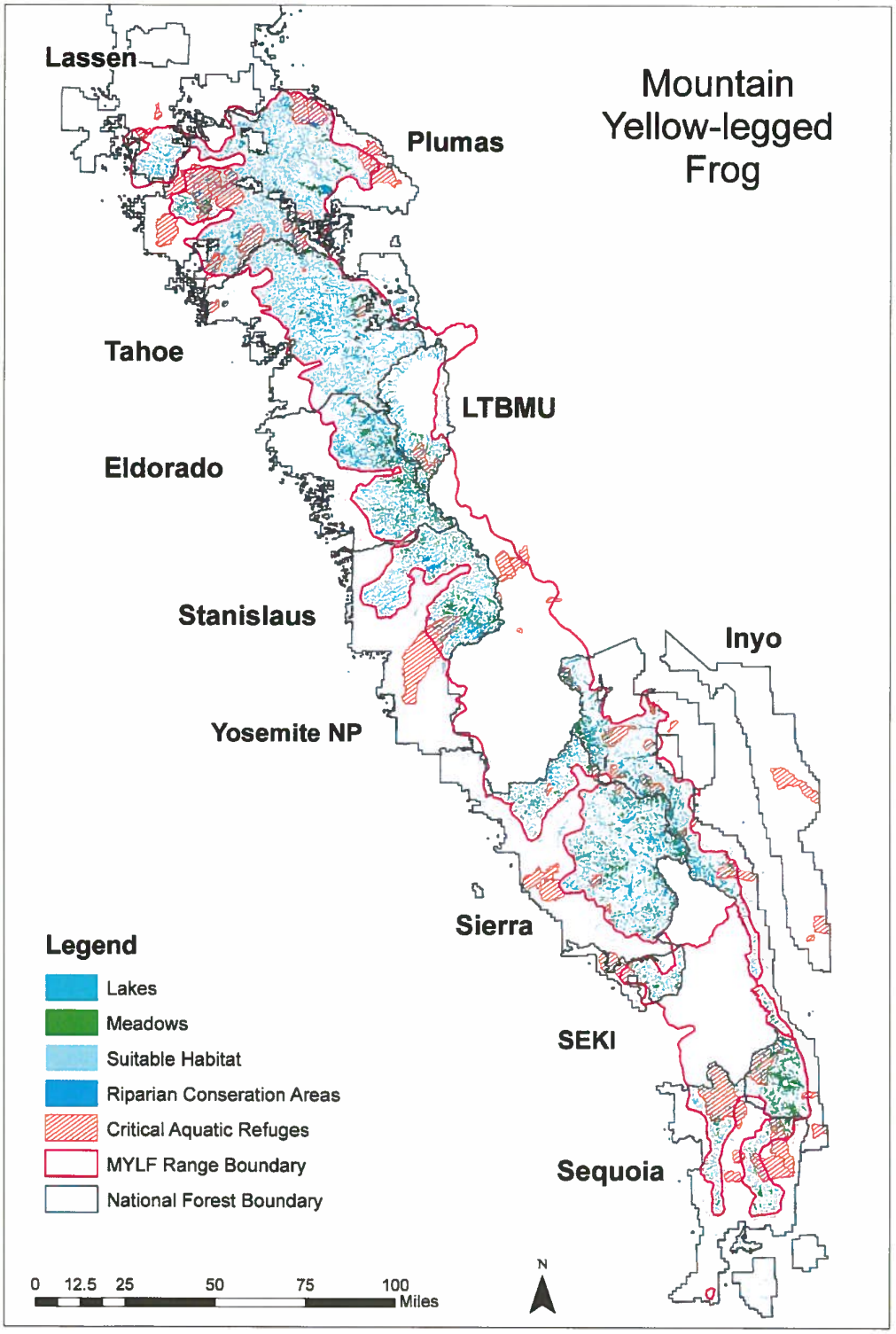
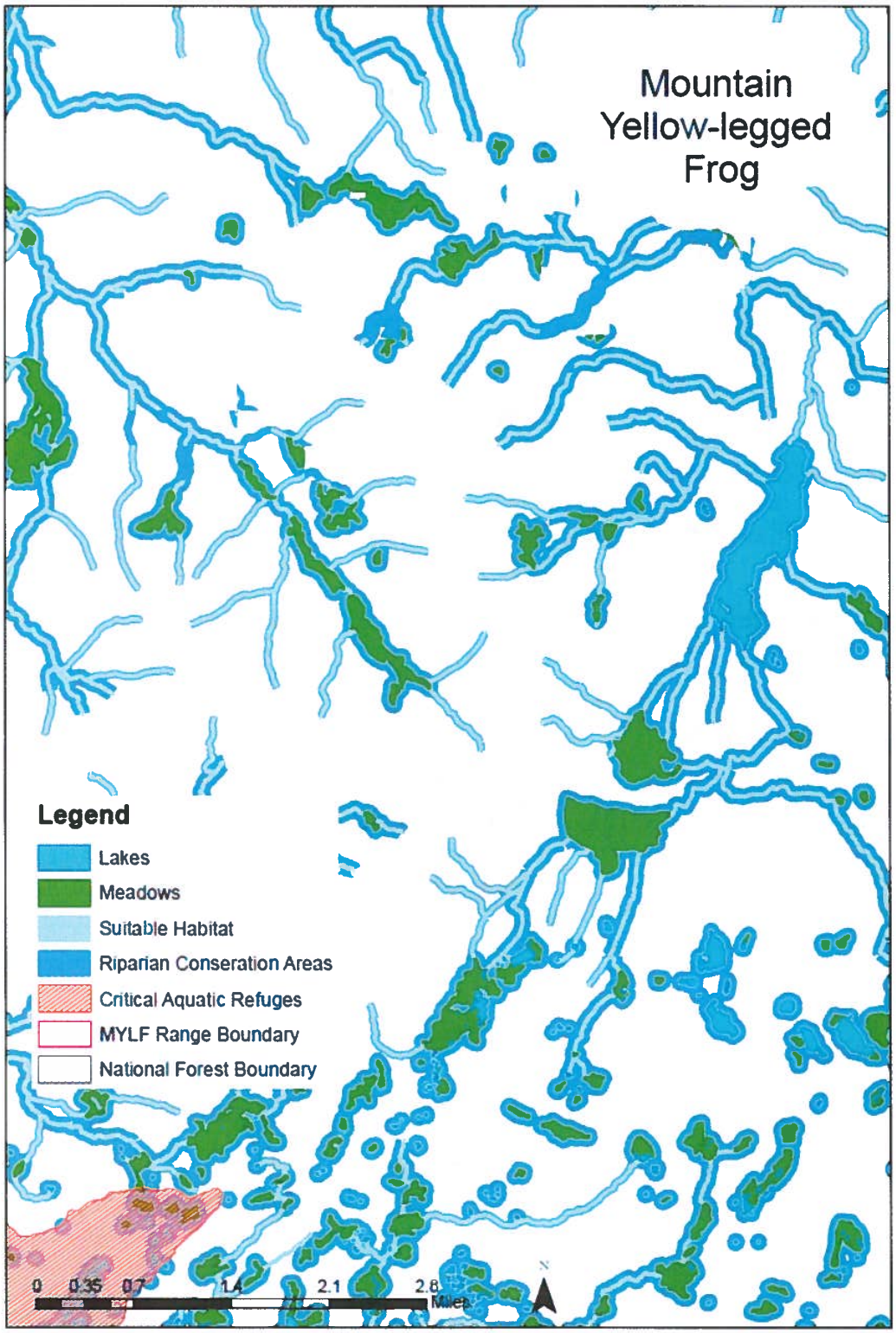


Figure 2. Mountain Yellow-Legged Frog Range (Zoom In)



mountain yellow-legged frogs may use a variety of shoreline habitats, both tadpoles and adults are less common at shorelines that drop abruptly to a depth of 2 feet than at open shorelines that gently slope up to shallow waters of only 2 to 3 inches in depth (Mullally and Cunningham 1956; Jennings and Hayes 1994).

The mountain yellow-legged frog is most abundant in high-elevation lakes and slow-moving portions of streams (Vredenburg *et al.* 2005; Zweifel 1955; Lannoo 2005; Mullally and Cunningham 1956). The borders of alpine ponds, lakes, and meadow streams above the tree line used by the two listed frogs are frequently grassy or muddy. The frog uses different aquatic habitats in various parts of its range, likely because of differences in availability. For example, the species is often found in streams in the northern and southernmost parts of its range where lakes are less common. At lower elevations within their historical ranges, they animals are known to be associated with rocky streambeds and wet meadows surrounded by coniferous forest (Vredenburg *et al.* 2005; Zweifel 1955; Zeiner *et al.* 1988). Adults use streams that vary from high-gradient channels replete with pools, rapids, and small waterfalls to reaches with marshy edges and sod banks (Brown *et al.* 2014; Foote *et al.* 2013; Zweifel 1955. Aquatic substrates vary from bedrock to fine sand, rubble consisting of rock fragments, and boulders (Zweifel 1955). Mountain yellow-legged frogs appear absent from the smallest creeks, possibly because these creeks have insufficient depth for adequate refuge and overwintering habitat (Jennings and Hayes 1994). Stream-dwelling yellow-legged frogs on the Plumas National Forest have been found in first order headwater streams to second order streams (Brown *et al.* 2014).

In the central and southern Sierra, the mountain yellow-legged frog breeds most commonly in permanent, deep lakes (Knapp and Matthews 2000a; Knapp *et al.* 2000b). In Yosemite National Park, occupancy was associated with deep water, elevation, absence of fish, and meadow vegetation on shorelines (Knapp 2005a). Adult mountain yellow-legged frogs breed in the shallows of ponds or in inlet streams (Vredenburg *et al.* 2005). Breeding has been observed in relatively shallow sites (< 1 foot) that dry frequently, but successful recruitment will only occur in water bodies that hold water for the duration of the 2-3 year larval period, even if only a small fraction of water remains (Lacan *et al.* 2008). They emerge from overwintering sites immediately following snowmelt, and will move over ice to reach breeding sites (Pope 1999; Vredenburg *et al.* 2005). The females deposit their eggs underwater in clusters, which they attach to rocks, gravel, or vegetation, or under banks (Wright and Wright 1949; Stebbins 1951; Zweifel 1955; Pope 1999).

In lakes in the John Muir Wilderness and Kings Canyon National Park, the presence of tadpoles was associated with deep water depths, elevation, the absence of trout, higher proportions of silt, and degree of lake isolation (Knapp *et al.* 2000b). Frogs also breed less commonly in streams and meadows (Zweifel 1955). The larvae take two to three years to metamorphose into subadults (Bradford 1983; Zweifel 1955) and their deep water habitat protects them from freezing to death in the winter (Bradford 1983; Knapp *et al.* 2000b; Knapp 2005a). Habitat models, based on broad scale sampling throughout Yosemite National Park and portions of the John Muir Wilderness and Kings Canyon National Park, indicate that the probability of occupancy by mountain yellow-legged tadpoles increased as maximum lake depth increased from 0 to 13 feet or 16 feet and then remained relatively constant at greater depths (Knapp *et al.* 2000; Knapp 2005a). Desiccation of tadpoles in habitats that dry out during the summer was an important cause of mortality, and little evidence was found of winterkill in shallow water habitats (Lacan *et al.* 2008; Bradford 1983).

Bradford (1983) found that mountain yellow-legged frog die-offs sometimes result from oxygen depletion during winter in lakes less than 13 feet in depth. However, tadpoles may survive for months in nearly anoxic conditions in shallow lakes that are frozen to the bottom. Populations of mountain yellow-legged frogs have overwintered in lakes less than 5 feet deep that are assumed to have frozen to the bottom, and healthy frogs emerged the following July (Pope and Matthews 2001; Pope 1999). Radio telemetry indicated that the animals were utilizing rock crevices, holes, and ledges near shore, where water depths ranged from 0.7 foot to 5 feet (Pope and Matthews 2001). The granite surrounding these overwintering habitats probably insulates mountain yellow-legged frogs from extreme winter temperatures, provided there is an adequate supply of oxygen (Pope and Matthews 2001). In lakes and ponds that do not freeze to the bottom in winter, they may overwinter in the shelter of bedrock crevices as a behavioral response to the presence of introduced trout (Vredenburg *et al.* 2005).

Mountain yellow-legged frog tadpoles maintain a relatively high body temperature by selecting warmer microhabitats (Bradford 1984). During winter, tadpoles remain in warmer water below the thermocline, the transition layer between thermally stratified water. After spring overturn (thaw and thermal mixing of the water), they behaviorally modulate their body temperature by moving to shallow, near shore water when warmer days raise surface water temperatures. The tadpoles select the warmest temperature environments within an alpine lake, often using shallow shorelines during the day and moving offshore in the evening as surface temperatures cool (Bradford 1984). Warmer waters are conducive to faster development. During winter, tadpoles remain in warmer water below the thermocline, the transition layer between thermally stratified water. Tadpoles may take more than 1 year to mature (Wright and Wright 1949), and often require 2 to 4 years, to reach the metamorphosis stage in which they transform from tadpoles to frogs, depending on local climate conditions and site-specific variables (Bradford 1983; Bradford *et al.* 1993; Knapp and Matthews 2000b; Vredenburg *et al.* 2005).

The time required to reach reproductive maturity in mountain yellow-legged frogs is thought to vary between 3 and 4 years post-metamorphosis (Vredenburg *et al.* 2005; Zweifel 1955). Based on this, given the amount of time a tadpole takes to reach metamorphosis, it may take 5 to 8 years for a mountain yellow-legged frog to begin reproducing. Adults are long lived with a maximum recorded age of 14 years (Vredenburg *et al.* 2005). Under normal circumstances, adult survivorship from year to year is very high (Pope 1999).

After breeding, adults may disperse into a larger variety of aquatic habitats (Pope and Matthews 2001). They appear to use a restricted set of lakes that provide suitable microhabitats for breeding and overwintering, then disperse into a greater number of sites during the summer months for feeding (Pope and Matthews 2001; Matthews and Preisler 2010; Pope and Matthews 2001; Wengert 2000). Frogs commonly are found basking in open areas near cover and water (Grinnell and Storer 1924; Mullally and Cunningham 1956; Storer 1925). Mullally and Cunningham (1956) found individuals more commonly along shallow, rocky shorelines often interspersed with vegetation rather than areas with large boulders from talus slope or sandy unprotected shorelines. The animals use a variety of cover including vegetation, logs, and partially submerged trees. Different habitats are used seasonally. Individuals select undercut banks and willows in August and rocky habitats in September and October (Pope and Matthews 2001). Similar to tadpoles, the adults and subadults seek warmer water, and Bradford (1984) found the abundance of frogs within a lake was significantly associated with warmer water. During the late afternoon and evening, mountain yellow-legged frogs move to offshore waters that are less subject to night cooling (Bradford 1984).

Mountain yellow-legged frog's display strong site fidelity and may return to the same overwintering and summer habitats from year to year (Pope 1999). In aquatic habitats of high mountain lakes, adults typically move only a few hundred yards (Pope and Matthews 2001; Pope 1999). In one telemetry study in lentic habitats, mountain yellow-legged frogs typically moved a few hundred feet during the active season (Brown *et al.* 2014; Pope and Matthews 2001). Distances greater than 0.621 mile have been recorded which included overland travel (Pope and Matthews 2001; Vredenburg *et al.* 2005). Moreover, given Barrowclough's (1978) caution that without extraordinary effort, population movement distances are consistently underestimated, the limited available data undoubtedly underestimate the movement patterns and capabilities of mountain yellow-legged frogs. At the scale of distances between lakes in many high Sierra basins, the data indicate that the species are capable of recolonizing other water bodies on a local scale. However, more studies of dispersal and movement will be necessary to elucidate their seasonal movements.

Adult mountain yellow-legged frogs move between breeding, feeding, or non-breeding active season, and overwintering habitats during the course of the year (Pope 199a; Matthews and Preisler 2010). Adults sometimes travel over ice or snow to reach preferred breeding locations early in the season without apparent ill effects (Pope 199a; Vrendenburg *et al.* 2005). Mullally and Cunningham (1956) stated that the animal avoids crossing dry ground over short distances, but individuals have been recorded moving overland for distances of 217 feet to 1312 feet (Pope and Matthews 2001; Vredenburg *et al.* 2005). However, the physical conditions under which the movements occurred are unclear. Movement of adults between habitats used in their seasonal rounds may be a function of the relative proximity of habitats that can fulfill their seasonal requirements, such as breeding, foraging, or overwintering; if all habitats that adults need are close to each other, seasonal movements may not be as great (Brown *et al.* 2014). In this context, trout occupancy in selected water bodies may force mountain yellow-legged frogs to move greater distances to fulfill their habitat requirements.

Status and Threats

The mountain yellow-legged frog is imperiled by a variety of factors, especially invasive trout, chytrid fungus, and global climate change (Bradford 1989, 1991; Bradford *et al.* 1998; 1994; Drost and Fellers 1996; Lannoo 2005; Moyle *et al.* 1996; Knapp and Matthews 2000a; Armstrong and Knapp 2004; Knapp 2005a, 2005b; Finlay and Vrendenburg 2007; Knapp *et al* 2007; Lacan *et al.* 2008; California Department of Fish and Wildlife 2011; Bradford *et al.* 2011).

Demographic data on historical populations of mountain yellow-legged frogs are anecdotal and limited. Essentially, no data actually precede the fish-planting era in the high mountain lakes and streams; the earliest recorded plantings date from the mid-1800s (Knapp 2005a). Nevertheless, mountain yellow-legged frog data from the earliest 20th Century dates available describe them as having been abundant in aquatic habitats in the high Sierra Nevada. Grinnell and Storer (1924) reported that it [=Sierra Nevada yellow-legged frog] was "…the commonest amphibians in most parts of the Yosemite section. Its total range is…less than that of the Pacific tree-toad [=Pacific tree frog]; but it numbers, especially at the higher altitudes, far exceed those of the smaller species. This frog is the species most likely to come to the attention of fishermen and others who may walk along the banks of Sierran streams and lakes." They also reported that "Certain of the lakes in the higher parts of the Yosemite contain large numbers of yellow-legged frogs in …tadpole and adult conditions" (Grinnell and Storer 1924).

The decline of the mountain yellow-legged frog was first recorded in the 1970's when large populations were reduced in size to near extirpation (Bradford 1991). Subsequent surveys of formerly occupied sites found few remaining populations (Bradford *et al.* 1994; Drost and Fellers 1996). Between 1988 and 1991, Bradford *et al.* (1994) resurveyed sites historically known to support mountain yellow-legged frogs, based on surveys from 1955 to 1979. Animals were not detected at 27 historical sites on the Kaweah River; they were observed at 52 percent of the historical sites within Sequoia and Kings Canyon National Parks, and at 12.5 percent of the historical sites outside of these two protected locations. When the Sierra Nevada yellow-legged frog and the Northern Distinct Population Segment of the mountain yellow-legged frog are combined for the purpose of analysis, into one species, the mountain yellow-legged frog, this resurvey effort detected them at 19.4 percent of historical sites (Bradford *et al.* 1994). Drost and Fellers (1996) repeated Grinnell and Storer's early 20th century surveys, and reported their presence at 2 of 14 historical sites. The two positive sightings consisted of a single tadpole at one site and a single adult female at the second. They located 17 additional sites with suitable mountain yellow-legged frog habitat, and detected three additional populations.

Davidson *et al.* (2002) reviewed 255 previously documented locations with mountain yellow-legged frog based on Jennings and Hayes (1994) throughout the historical range, and they concluded that 83 percent of these sites no longer support extant populations. Vredenburg *et al.* (2007) compared recent surveys from 1995 to 2004 with museum records of specimens collected between 1899 to 1994 and found that 93.3 percent of locations with historic records of the Sierra Nevada yellow-legged frog sites, and 95.2 percent of the sites with historic records of the Northern Distinct Population Segment of the mountain yellow-legged frog were extirpated. The California Department of Fish and Wildlife (2014a, 2014b) updated the Vredenburg *et al.* (2007) study utilizing historic locality records from museum specimens during the same time interval (1899–1994), and included updated recent locality information with additional survey data (1995–2010). These recent surveys failed to detect any extant frog populations within 0.63 mile of 220 of 318 localities with historic Sierra Nevada yellow-legged frog records and 94 of 109 localities with historic mountain yellow-legged frog records. Based on this study, the estimated loss from historic occurrences is 69 percent for the Sierra Nevada yellow-legged frog and 86 percent for the Northern Distinct Population Segment of the mountain yellow-legged frog.

In 2002, 302 water bodies known to have been occupied by the mountain yellow-legged frog and 744 sites where the species had not been detected were resurveyed between 1995 and 1997 (Knapp 2005a). Animals at 59 percent of the previously occupied sites, and 8 percent of previously unoccupied sites were recolonized (Knapp 2005a). These data suggest an extirpation rate five to six times higher than the colonization rate within this study area. The documented extirpations appeared to have occurred non-randomly across the landscape, typically spatially clumped, and included the disappearance of all or nearly all of the mountain yellow-legged frog populations in a watershed (Knapp 2005a). The California Department of Fish and Wildlife (2014a, 2014b) assessed data from sites where multiple surveys were completed since 1995 at least 5 years apart. The Sierra Nevada yellow-legged frog was not detected at 45 percent of sites where they previously had been confirmed, and the mountain yellow-legged frog including the endangered Southern Distinct Population Segment, was not detected at 81 percent of the historically occupied sites. These data combined with the Forest Service's monitoring data suggest that declines continued into the 1990s.

The Forest Service conducted bioregional monitoring for the mountain yellow-legged frog on National Forest lands within the species' range in the Sierra Nevada as part of their Sierra Nevada

Amphibian Monitoring Program (Brown *et al.* 2014). This monitoring effort provided scientifically-based estimates for statistical comparisons of occupancy and relative abundance across 5-year monitoring cycles based on a sample of 208 watersheds (Brown *et al.* 2014). The results of this monitoring, from 2002-2009, found mountain yellow-legged frog breeding activity in 4 percent of watersheds rangewide, and the species has declined in both distribution and abundance. Evidence of breeding was found in only 47 percent of watersheds where the animal had been found relatively recently (1990-2001), and in only 2 percent of watersheds where the species had last been observed prior to 1990. Moreover, relative abundances were low; only an estimated 9 percent of occupied watersheds were large, numbering more than 100 frogs or 500 tadpoles, and more than half of the watersheds (57 percent) had fewer than 20 animals (>10 tadpoles and >10 adults or subadults) (Brown *et al.* 2014).

The introduction of trout to historically fish-free lakes in the Sierra Nevada reduced the distribution and abundance of the Sierra Nevada yellow-legged frog and the Northern Distinct Population Segment of the mountain yellow-legged frog (Bradford 1989; Knapp and Matthews 2000a; Knapp 2005a). Prior to the mid-Nineteenth Century, almost all lakes and associated streams in the Sierra Nevada above 6000 feet were fishless (Moyle *et al.* 1996). As a result of 150 years of fish stocking throughout the region, however, all watersheds now contain as many as five non-native trout species (Forest Service 2013b). Currently, these areas may be functioning as population sinks for the mountain yellow-legged frog because the fish are either self-sustaining or their reintroduction to waterways and waterbodies imperils the amphibians.

The biological and ecological characteristics of the mountain yellow-legged frog make it especially vulnerable to predation and subsequent extirpation by introduced trout (Bradford 1989; Bradford *et al.* 1998; Finlay and Vredenburg 2007; Knapp and Matthews 2000a; Knapp *et al.* 2011). First, adult mountain yellow-legged frogs are highly aquatic and inhabit alpine lakes, most of which now contain trout. Second, in contrast to the tadpoles of other Sierra Nevada frog species that complete their metamorphosis to their terrestrial stage in a single summer, mountain yellow-legged frog larvae generally require at least two years to complete metamorphosis. This overwintering requirement restricts successful breeding and development to permanent water bodies that typically are deeper than six feet, however, they may be subject to predation by introduced trout in these locations (Brown *et al.* 2014; Bradford 1983; Knapp and Matthews 2000a; Mullally and Cunningham 1956). And third, by excluding the mountain yellow-legged frog from deep lakes, trout increase the isolation of the remaining populations of these amphibians.

In 2000, the California Department of Fish and Wildlife declared that no waters would be approved for fish stocking in which the mountain yellow-legged frog were present or where the presence of this animal was unknown due to a lack of recent surveys (California Department of Fish and Wildlife 2011). Based on an assessment of the status and distribution of the amphibian and the impacts on it from fisheries. The California Department of Fish and Wildlife reduced the number of high elevation Sierra Nevada waters stocked by 77 percent (California Department of Fish and Wildlife 2011). This was due in part to efforts to eliminate stocking of waters in the immediate vicinity of mountain yellow-legged frog populations, but also because of the results of resource assessments that showed that many trout populations were self-sustaining and did not require stocking to persist (California Department of Fish and Wildlife 2011).

Another significant threat to the two listed amphibians is chytrid fungus (*Batrochytridium mycosis* = *Bd*). This fungus may have arrived in the Sierra Nevada in the 1960s or 1970s (Vredenburg *et al.* 2010) and is now present in most aquatic habitats in this bioregion. *Bd* is a waterborne fungus which is transmitted by a free-swimming zoospore that infects the keratinized tissue of amphibian skin (Berger *et al.* 1998). It disrupts critical skin functions such as osmoregulation (Voyles *et al.* 2007, 2009). Post-metamorphic frogs are most susceptible to the disease. It is responsible for amphibian declines and extinctions worldwide (Skerratt *et al.* 2007; Longcore *et al.* 1999; Mao *et al.* 1999). The chytrid fungus has contributed to widespread mountain yellow-legged frog declines throughout the Sierra Nevada (Briggs *et al.* 2010; Rachowicz *et al.* 2006; Vredenburg *et al.* 2010). Adults may shed *Bd* and persist with low levels of infection, but given their highly aquatic habitat requirements, likely are reinfected by tadpoles that can carry high infection loads (Briggs *et al.* 2010, Vredenburg *et al.*, 2010). Some populations appear to be persisting with chytrid at reduced abundances (Briggs *et al.* 2010). Research is underway to better understand the epidemiology of *Bd* in the mountain yellow-legged frog and to attempt to develop effective treatments (Stice and Briggs 2010; Vredenburg *et al.* 2010).

The majority of remaining mountain yellow-legged frog populations are small (Brown *et al.*, 2011) and many are isolated (Bradford *et al.* 1993; California Department of Fish and Wildlife 2011; Knapp *et al.* 2007). Small and isolated populations are vulnerable to stochastic events, such as severe weather or predation that can lead to their decline and extirpation (Shaffer 1981). Small populations also have increased chance of genetic drift and inbreeding, which can lead to losses in genetic variation (Service 2014). The high degree of site fidelity also increases the vulnerability of small populations if frogs continue to return to habitats that are no longer suitable due to fish introductions or climate change. Given the few populations remaining in the Sierra Nevada, losses of even a few populations of the mountain yellow-legged frog may be significant.

The Sierra Nevada yellow-legged frog and the Northern Distinct Population Segment of the mountain yellow-legged frog occur within the action area as demonstrated by: (1) recent observations of these two listed species on Forest Service lands in the Sierra Nevada; (2) the biology and ecology of the animals, especially the ability of individuals to move distances and their ability to spend the dry months of the year in upland habitats with suitable environmental conditions; and (3) the action area contains physical features that provide refuge, forage, and dispersal habitat for the amphibians.

Yosemite Toad.

The Yosemite toad was listed as a threatened species on April 29, 2014, under the Endangered Species Act of 1973, as amended (U.S. Fish and Wildlife Service 2014).

The Yosemite toad was originally described as *Bufo canorus* by Camp (1916), who gave it the common name of Yosemite Park toad. Grinnell and Storer (1924) referred to it as the Yosemite toad when they found the species' range extended beyond the boundaries of Yosemite National Park.

Frost *et al.* (2006) divided the paraphyletic genus *Bufo* into three genera, assigning the North American toads, including the Yosemite toad, to the genus *Anaxyrus*. Feder (1977) found the Yosemite toads are the most genetically distinct member of the *boreas* group based on samples from a limited geographic range. However, it hybridizes with western toads in the northern part of their range (Blair 1972; Karlstrom 1962; Morton and Sokolski 1978). Shaffer *et al.* (2000) analysed a segment of mitochondrial DNA from 372 individuals collected in Yosemite National Park and

Sequoia-Kings Canyon National Parks. They found there are significant genetic differences in Yosemite toads between the two National Parks. The genetic divergence in individuals from regionally proximate populations was high, implying low rates of genetic exchange.

Physical Description

The Yosemite toad is a moderately sized amphibian, with the adults ranging in size from 1.2 inches to 2.8 inches from the tip of their snout to their urostyle, a bony structure at the posterior end of the spinal column (Karlstrom 1962; Dodd 2013a; Lannoo 2005). A thin mid-dorsal stripe is present in juveniles of both sexes. The stripe disappears or is reduced with age; this process takes place more quickly in males (Dodd 2013a; Lannoo 2005). The iris of the eye is dark brown with gold iridophores (Dodd 2013a). The large paratoid glands are rounded to slightly oval in shape.

Male Yosemite toads are smaller than the females, and they have less conspicuous warts (Stebbins 1951, 2003; Stebbins and McGinnis 2012; Dodd 2013a; Green *et al.* 2014; Lannoo 2005). Differences in coloration between males and females are more pronounced in this species than in any other North American frog or toad (Stebbins 1951). Females have black spots or blotches edged with white or cream set against a grey, tan, or brown background color (Jennings and Hayes 1994). Males have a nearly uniform dorsal coloration of yellow-green to olive drab to darker greenish brown (Dodd 2013a; Green *et al.* 2014; Lanoo 2005).

Current Range and Distribution

The Yosemite toad is restricted to the Sierra Nevada in California from the Blue Lakes region north of Ebbetts Pass in Alpine County to just south of Kaiser Pass in the Evolution Lake/Darwin Canyon area in Fresno County (Green *et al.* 2014; Dodd 2013a; Lannoo 2005; Stebbins and McGinnis 2012; Jennings and Hayes 1994; Liang *et al.* 2010; Liang and Stohlgren 2011). The species historically inhabits elevations ranging from 6,000 to 11,910 feet (Stebbins 2003; Stephens 2001).

Approximately 72 percent of the Yosemite toad's range occurs on lands managed by the Forest Service (Forest Service 2014); a significant portion, 57 percent, is located within wilderness areas. There are a number of records of extant populations in the California Natural Diversity Data Base (California Department of Fish and Wildlife 2014a, 2014b). There is suitable habitat for the Yosemite toad in 4 National Forests (Figure 3).

Habitat and Life History

Terrestrial habitats utilized by Yosemite toad adults vary, particularly by elevation, and include forests, meadows, shrublands, rock outcrops, and talus. Mid-elevation meadows occur in yellow pine (mixed conifer) and lower edges of lodgepole-red fir forests. Meadows above 7,500 feet generally occur in lodgepole–red fir, subalpine and alpine ecosystems (USFS 2001b). Higher subalpine and alpine areas tend to be more open than lower elevation regions. Yosemite toads inhabit wet meadow habitats and lake shores surrounded by lodgepole or whitebark pines (Camp 1916, 1917; Dodd 2013a; Stebbins and McGinnis 2012; Lannoo 2005; Wang 2012). The species is most often found in areas with thick meadow vegetation or patches of low willows (Dodd 2013a; Mullally 1953). Liang (2010) observed Yosemite toads most frequently associated with, in order of preference: wet meadows, alpine-dwarf scrub, red fir, water, lodgepole pine, and subalpine conifer habitats.

The Yosemite toad generally is associated with meadows because these are the areas used as breeding habitat. After breeding, adults move into the surrounding uplands. Yosemite toads emerge at snowmelt to breed, generally May-June depending on location and snowpack, and are active above ground for approximately four months each year, reentering overwinter sites in the fall when the weather becomes cold (Kagarise Sherman and Morton 1993, Karlstrom 1962). Upon emergence, males form breeding choruses (Kagarise Sherman 1980, Kagarise Sherman and Morton 1984) and breeding takes place over a short period of time ranging from a few days to 2-4 weeks (Brown *et al.* 2012; Kagarise Sherman 1980; Sadinski 2004). Males usually remain at breeding areas for 1-2 weeks whereas females usually spawn within 1-2 days (Kagarise Sherman and Morton 1984). Eggs hatch in about 4-15 days, depending on ambient water temperatures. Tadpoles metamorphose in an average of 48–63 days and do not overwinter (Kagarise Sherman 1980, Karlstrom 1962).

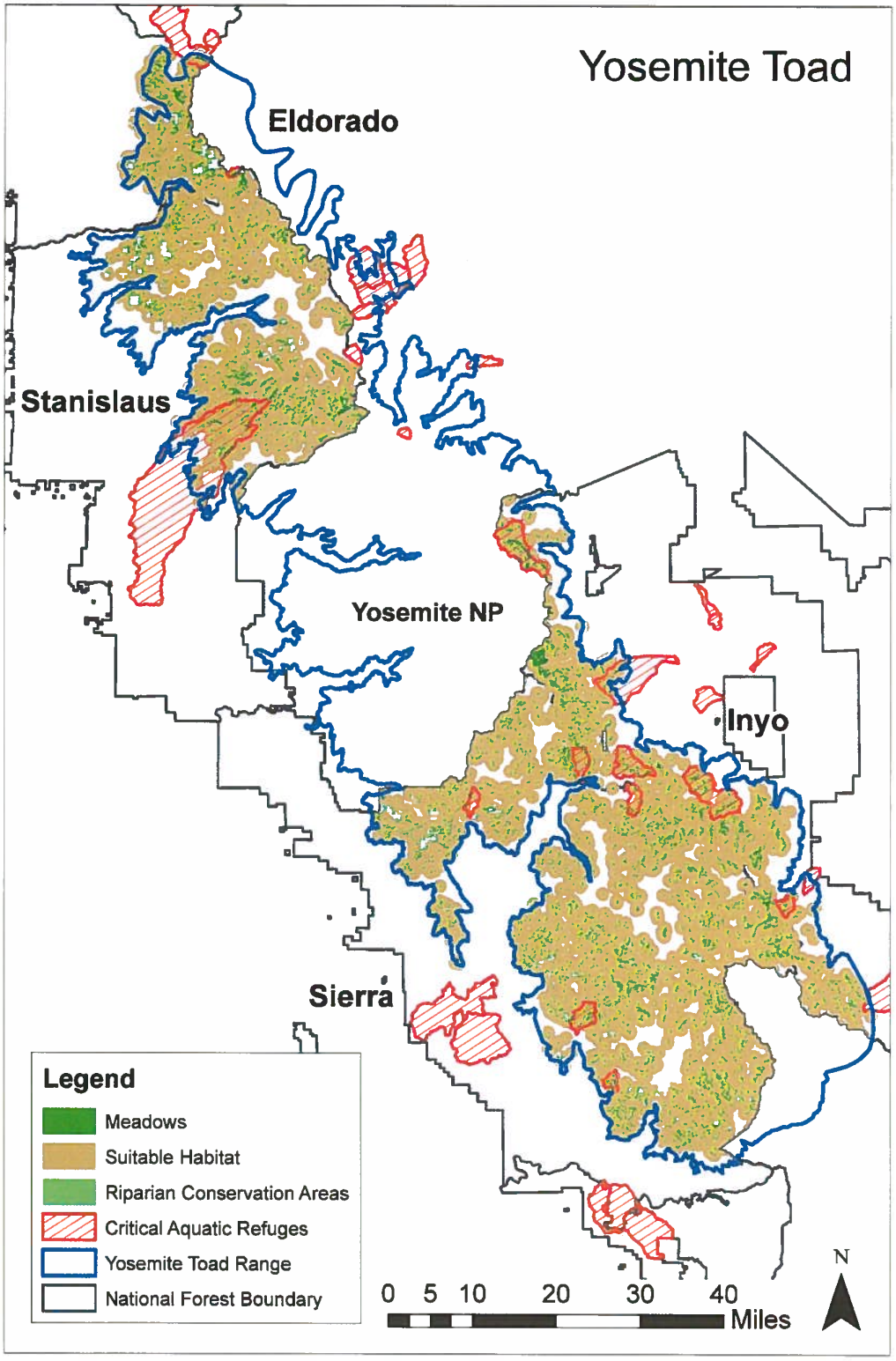
Yosemite toads are found at both large and small sites (Liang 2010), indicating that this species is capable of successfully utilizing small habitat patches. Liang (2010) found that population persistence was greater at higher elevations, with an affinity for relatively flat sites with a southwesterly aspect. These areas receive higher solar radiation and are capable of sustaining hydric, seasonally ponded, and mesic breeding and rearing habitat. The Yosemite toad is more common in areas with less variation in mean annual temperature, or more temperate sites with less climate variation (Liang 2010).

The Yosemite toad is a late maturing, long-lived species. Females first breed when they are 4-6 years old and males at 3-5 years of age (Kagarise Sherman 1980). Estimates of apparent annual survival of adult males in six meadows ranged from 50 percent to 72 percent (Brown *et al.* 2012). Some females may live as long as 15 years and males up to 12 years (Kagarise Sherman and Morton 1984). Periodic years of high recruitment and high survival rates of adults maybe important for the long-term persistence of populations (Biek *et al.* 2002; Brown *et al.* 2012).

Yosemite toads likely are more nocturnally active than has previously been reported. They actively breed during the day, but a recent study found them to be equally active at night (Brown *et al.* 2009). Martin (2008) and Liang (2010) observed movement of adults both during the day and night, and they speculated that long distance movements occur during the hours of darkness.

The breeding habitat of the Yosemite toad include very shallow waters, most commonly in wet meadows, but also in lake edges, and slow-moving streams and sloughs (Kagarise Sherman 1980; Karlstrom and Livezey 1955; Karlstrom 1962; Martin 2008; Mullally 1953). On the Sierra National Forest, Liang (2010) observed breeding in both large and small meadows, indicating that this species is capable of successfully utilizing small habitat patches. Liang (2010) found breeding site occupancy was greater in seasonal waters in relatively flat sites facing a southwesterly direction with warmer water temperatures. Breeding sites were associated with higher elevations, less variable air temperatures, more precipitation in the warmest three months of the year, and less precipitation during the driest three months. Liang (2010) also noted that the species' distribution was related to a number of different factors rather than a small set of variables. In Yosemite National Park, Knapp (2005a) found high elevation and meadow shorelines were significantly correlated with occurrence. Roche *et al.* (2012a) found annual occupancy to be positively correlated with annual precipitation.

Figure 3. Yosemite Toad Suitable Habitat Range Map



In the late winter or early spring, male Yosemite toads exit their upland burrows before the females, and they spend more time in the breeding pools (Kagarise Sherman and Morton 1993). Most adult males appear to breed annually, whereas females may skip years between breeding (Kagarise Sherman 1980; Morton 1981; Brown *et al.* 2012). Females have high lipid storage levels, and there may be a trade-off between its use to enhance overwinter survival and the energetic expense of breeding every year (Morton 1981). The Yosemite toad is a prolific breeder that lays many eggs immediately at snowmelt over a short period of time. The reproductive output of the females is relatively high with estimates that some individuals may lay from 1,100 to 2,000 eggs in a single season (Kagarise Sherman 1980; Karlstrom and Livezey 1955; Karlstrom 1962). Females may split their egg clutches within the same pool, or even between different pools, and eggs may be communally laid with other toads (USFS *et al.* 2009). Mortality of eggs and tadpoles caused by freezing or desiccation may be high in some years leading to low or no recruitment (Brown *et al.* 2012; Kagarise Sherman 1980; Sadinski 2004).

The characteristics of Yosemite toad breeding sites generally are associated with warm environments conducive to rapid development (Kagarise Sherman and Morton 1984; Karlstrom 1962). This includes hydroperiods of sufficient length for successful metamorphosis. The female Yosemite toads generally lay their eggs in very shallow, warm, and often ephemeral water at the edges of small pools or in flooded meadow vegetation, most commonly with no or low flow (Kagarise Sherman 1980; Mullally 1953; Sadinski 2004). The tadpoles are most commonly observed in shallow warmer water, and the will move from cooler to warmer locations within a breeding site (Mullally 1953; Karlstrom 1962; Kagarise Sherman and Morton 1984). The eggs are laid at depths ranging from 1.5 inches to 3 inches with a median depth of about 2.5 inches (Sadinski 2004; Kagarise Sherman 1980; Karlstrom 1962; Roche *et al.* 2012a).

After the breeding period, adults Yosemite toads disperse into meadows, ephemeral streams, seeps and springs, and uplands (Liang 2010; Martin 2008). One telemetry study on the Stanislaus National Forest found that they moved a maximum distance of 2,156 feet (Martin 2008), another study recorded an individual had moved 4,137 feet in the Sierra National Forest (Liang 2010), and Morton and Pereyra (2010) found animals 2,789 feet away from their breeding pools. Females are recorded to move further than males. In the telemetry study on the Sierra National Forest, the maximum distance travelled by females was 4,137 feet versus 2,838 feet by males, and the average distance travelled by females was twice that of males (Liang 2010). At Tioga Pass Meadows, 64 percent of females were in the furthest zone, 2,789 feet from the breeding pools, compared with only 4 percent of males. In contrast, 54 percent of males were found in the breeding meadows, compared with 19 percent of females (Morton and Pereyra 2010). Liang (2010) found that most long-distance travel was undertaken in the first 60 days after the breeding period, and individuals often stayed in the same location for several days or weeks. Adult females utilized different habitat than adult males during the non-breeding season (Morton and Pereyra 2010). Morton and Pereyra (2010) found that during late July and August, over 60 percent of Yosemite toads in upland rocky hillside habitat were adult females and less than 10 percent were adult males. In lowland meadow habitat near a breeding pond, 54 percent of the individuals were adult males and about 19 percent were adult females.

Overwintering habitat of the Yosemite toad may include rodent burrows, crevices under rocks and stumps, and root tangles at the base of willows (Davidson and Fellers 2005, Kagarise Sherman 1980, Martin 2008). Some metamorphs appear to overwinter their first year in the terrestrial meadow habitat adjacent to their rearing site and move to more distant terrestrial habitat during mid-summer of their second year (Kagarise Sherman and Morton 1993; Morton and Pereyra 2010).

Individual Yosemite toads show fidelity to breeding meadows and adult habitats (Brown *et al.* 2012; Kagarise Sherman and Morton 1984; Liang 2010). In Tioga Pass Meadows, most of the males and females returned to the same breeding sites (Kagarise Sherman and Morton 1984). During four years of a mark-recapture study, only three of 37 males moved to different meadows to breed, though males did move among breeding areas within meadows (Brown *et al.* 2012). In one radio telemetry study, individuals used the same upland nonbreeding areas and sometimes the same exact site for multiple years (Liang 2010).

The only long-term, site-specific population study of the Yosemite toads found a dramatic decline over 2 decades of monitoring. Kagarise Sherman and Morton (1993) studied the species at Tioga Pass Meadow from 1971 through 1991, with the most intensive monitoring between the years 1971 to 1982. A decline in the average number of males entering the breeding pools declined from 258 to 28 during the mid-1970s through 1982. During the same time period, the number of females varied between 45 and 100, but there was no apparent trend in number observed. During the 1980s, both males and females continued to decline, and breeding activity became sporadic. By 1991, only one male and two egg masses was found by Kagarise Sherman and Morton (1993). A similar population decline was recorded in local nonbreeding habitat.

Status and Threat

The Yosemite toad is imperiled by a variety of factors, especially damage or loss of habitat, global climate change, and chytrid fungus (Lannoo 2005; Martin 2008; Green *et al.* 2014 Davidson and Fellers 2005; Brown *et al.* 2011). The exact number of the remaining populations of the Yosemite toad is unknown, but the number of known occupied sites such as lakes, ponds, and meadows, streams is estimated to be around 740.

High meadow habitat quality in the western United States, and specifically the Sierra Nevada, has been degraded by various stressors over the last century (Vale 1987; Ratliff 1985). These various stressors have contributed to erosion and stream incision, leading to meadow dewatering and encroachment by invasive vegetation (Menke *et al.* 1996). The legacy of these impacts remains extant to this day in the ecosystems of the high Sierra Nevada (Vankat and Major 1978). Given the reliance of the Yosemite toad on these high meadow habitats for breeding, and early life history stage and adult survival, the various stressors likely have had an effect on the viability of their populations via the degradation of their habitat.

Since high meadows in the Sierra Nevada are dependent on their hydrologic setting, most meadow degradation is due fundamentally to hydrologic alterations. Montane meadows have been identified among the most vulnerable and impacted habitat types of the Sierra Nevada (Kattelmann and Embury 1996, U.S.Forest Service 2004). While impacts have varied depending on meadow hydrogeomorphic type (Weixelman *et al.* 2011), drying on meadow systems associated with streams where downcutting has occurred is one of the most significant forms of change that has occurred, primarily as a result of livestock overgrazing (Wagoner 1886; Ratliff 1985; Menke *et al.* 1996). Roads and historic logging practices have resulted in meadow degradation in the form of drying, stream incision and creation of headcuts (Biological Assessment).

Livestock grazing was historically widespread in the Sierra Nevada and historically caused widespread degradation of meadows (Menke *et al.* 1996), such as those utilized by the Yosemite toad for breeding. Studies investigating the effects of livestock grazing on amphibians have found

positive, negative, and no associations, though most were not conducted in alpine meadows (Adams *et al.* 2009; Bull and Hayes 2000; Burton *et al.* 2009; Ford *et al.* 2013; Jansen and Healey 2003; Knutsen *et al.* 2004; Roche *et al.* 2012a; Lind *et al.* 2011; McIlroy *et al.* 2013).

Until recently, the effect of chytrid to Yosemite toad population declines was relatively unknown. Although the animal is hypothetically susceptible due to their co-occurrence with the Northern Distinct Population Segment of the mountain yellow-legged frog and Sierra Nevada yellow-legged frog, the spread and growth of chytrid in the warmer pool habitats, occupied for a much shorter time relative to the frogs may render individuals less prone to epidemic outbreaks (Green and Kagarise, Sherman 2001; USFS *et al.* 2009). Fellers *et al.* (2007) documented the occurrence of chytrid infection of Yosemite toad in Yosemite National Park over at least a couple of decades, and populations of the animal persisted in spite of the continued presence of the pathogen. In a survey of 196 museum specimens, Dodge and Vredenburg (2012) reported the first presence of Bd infection in Yosemite toads beginning in 1961, with the pathogen becoming highly prevalent during the recorded declines of the late 1970s, before it peaked in the 1990s at 85 percent positive incidence. Dodge and Vrendenburg (2012) collected 1,266 swabs from live Yosemite toads between 2006 and 2011, and they found Bd infection intensities at 17–26 percent, with juvenile toads most affected. The results from these studies support the hypothesis that chytrid have played an important role in Yosemite toad population dynamics over the period of their recent recorded decline.

Fire likely plays a significant role in the evolution and maintenance of meadows utilised by the Yosemite toad in the Sierra Nevada. Under natural conditions, conifers are excluded from meadows by fire and saturated soils. Small fires thin and/or destroy encroaching conifers, while large fires are believed to determine the meadow-forest boundary (Vankat and Major 1978). Fire is thought to be important in maintaining open aquatic and riparian habitats for amphibians in some systems, and fire suppression may have thereby contributed to conifer encroachment on meadows (U.S. National Park Service 2010).

Trampling and collapse of rodent burrows by hikers, livestock, pack animals, pets, or vehicles may have led to direct injury or death of the Yosemite toad. Recreational activity also may harass individuals and disrupt their behavior (Karlstrom 1962). Recreational anglers may be the transport mechanism of introduced pathogens and parasites, and they have been observed using toads and tadpoles as bait (USFS *et al.* 2009). However, Kagarise Sherman and Morton (1993) did not find a relationship between the distance from the nearest road and the declines in Yosemite toad populations, suggesting that human activity was not the cause of decline.

Small and isolated populations are vulnerable to stochastic events that can lead to their decline and extirpation (Shaffer 1981). For example, small populations are more likely to be devastated by adverse environmental factors than large populations. Small populations also have increased chance of genetic drift and inbreeding that can lead to losses in genetic variation (Service 2014). A high degree of site fidelity also can increase the vulnerability of small populations if Yosemite toads continue to return to habitats that are no longer suitable due to, for example, meadow degradation or climate change. Finally, some management activities may not adversely affect Yosemite toad populations across their range, but potentially may have significant effects on specific populations. Losses of even a few populations may be important in a declining species, such as this animal.

The Yosemite toad occurs within the action area as demonstrated by: (1) recent observations of the species on Forest Service lands in the Sierra Nevada; (2) the biology and ecology of the animal, especially the ability of individuals to move, forage, and winter in uplands; and (3) the action area contains physical features that provide refuge, breeding, foraging, and dispersal habitat for the amphibian.

Effects of the Proposed Action

Effects of the action refer to the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated and interdependent with that action, which will be added to the environmental baseline. Indirect effects are those that are caused by the proposed action and are later in time, but are still reasonably certain to occur.

Pre-activity surveys conducted for the Sierra Nevada yellow-legged frog, Northern Distinct Population Segment, Yosemite toad, and suitable habitat likely would reduce adverse effects resulting from projects in the nine Forest programs. The appropriate minimization measures will be implemented if individuals or suitable habitat are found. In addition, various BMPs and S&Gs as described in the Conservation Measures will also be implemented that will minimize the effects to the three listed amphibians. In addition, the Monitoring Program to be developed by the Forest Service in conjunction with the Service to evaluate compliance and implementation, take and the effectiveness of the conservation measures. This Program will ensure compliance as well as provide information on the effectiveness of these measures.

The nine Forest programs consist of a wide variety of activities that will adversely affect the Sierra Nevada yellow-legged frog, Northern Distinct Population Segment of the mountain yellow-legged frog, Yosemite toad, and their habitats. At the programmatic level, individuals may be captured, trapped, injured, killed, harmed, and harassed during implementation and operation of the specific projects. The activities in the nine Forest programs will adversely affect the three listed amphibians in the following ways:

1. <u>Vegetation Management, Timber Harvest, Fuels Management and Watershed Restoration</u>
   The potential effects from this Forest program include harm, harassment, capture, injury, and death of egg masses, tadpoles, subadults, and adults of the three listed amphibians. Individuals can be crushed, harassed, injured, or killed by earthmoving, yarding, skidding, construction of temporary roads, skid trails and landings; activities associated with falling trees, piling or burning; directly injuring or killing individuals; or trapping, injuring and killing individuals in burrows. The use of plastic netting and similar materials for erosion control could result in the entanglement and death of Yosemite toad and Sierra Nevada yellow-legged frog due to exposure, starvation, strangulation, or predation (Stuart *et al.* 2001). Prescribed fire activities could result in direct mortality from burning or crushing. Individuals using downed wood for cover may be killed, injured or disturbed during treatments for removal, piling, or burning.

   Vegetation management activities may cause noise, vibration, dust, and other disturbances to the three listed amphibians that result in their avoidance or abandonment of locations containing breeding, resting, movement, or foraging habitat.

   According to studies cited in the BA, direct fire related mortality of adult amphibians is rare, either because of the timing of the fire or because individuals are able to take refuge from fire in

burrows, moist ground, or water sources such as ponds (USFS 2013a). The immediate effects of wildfire in the form of mortality of individuals and failed reproduction, is expected to be a small threat to most healthy populations, unless stressors such as drought or persistent habitat change have left populations isolated or with an extremely limited distribution (USFS 2013a). The Boreal toad, a species closely related to the Yosemite toad, showed a positive response to fire events in western Montana (Hossack and Pilliod 2011; Bartelt 1998), colonizing recently burned wetlands and using severely burned forests more than moderately burned forests. The more severely burned areas had warmer surface and burrow temperatures even 3 years after the fire event (Hossack *et al.* 2009). Hossack *et al.* (2012) found a time-lagged decline in occupancy of the highly aquatic Columbia spotted frog associated with wildfire. Boreal toad occupancy tripled in the three years following wildfires and then returned to pre-fire levels. In the Pacific Northwest, prescribed fire may increase the mortality of terrestrial amphibians by fire because prescribed burning usually occurs in fall to spring when amphibians are active (Bury 2004).

The three listed amphibians likely will be adversely affected by ground disturbing activities that include end-lining, skidding, dozer piling, mechanical equipment use such as road maintenance, skid trail construction, timber cutting, log prep, skidding, loading, and landing creation and general ground related access to cutting trees with mechanical equipment or conventional logging. Potential effects from activities associated with vegetation management include disturbance and destruction of breeding, basking, refuge, and overwintering sites. Potential habitat alterations include changes to canopy and other vegetative and non-vegetative cover, air and water microclimates including temperature, water quantity and quality, hydro periods, increased nutrients, sedimentation, woody debris, and channel scour.

The Yosemite toad likely is likely more vulnerable to the effects of vegetation management than the Sierra Nevada yellow-legged frog and the Northern Distinct Population Segment of the mountain yellow-legged frog. The toad occurs in upland habitat outside of meadow habitat for much of the summer, in contrast to the mountain yellow-legged frog that tends to remain near water. The Yosemite toad also is slow moving and unable to quickly get out of the way of logging equipment, people, or other sources of direct danger.

Fuels and other toxic materials will be required to operate the machines and equipment utilized for vegetation management, timber harvest, fuels management, and watershed restoration. Application of herbicides and other chemicals used for reforestation or weed control may affect the three listed amphibians. Yosemite toads potentially are exposed to toxic materials in their terrestrial environments.

The reduction of canopy cover may benefit the three listed amphibians by increasing the amount of available warm water and basking sites or may adversely affect them if temperatures increase higher than their thermal tolerances or if cover is not available. The importance of canopy cover may vary among streams, lakes, meadows, and other suitable habitats. Liang (2010) found adults associated with forest clearings. Currently, it is not known if a reduction in forest canopy cover in upland habitat is beneficial or detrimental to Yosemite toad. The burrows, logs, tree roots, and stumps used for cover and refuge by the toad may be adversely affected by road reconstruction, temporary and skid trail construction and use, and fire line construction. Adults have been found to have site fidelity to burrows (Liang 2010).

Ground-disturbing activities and changes in vegetation can affect soil stability, erosion, and sediment loading to aquatic habitats. Sedimentation can result from disturbance of stream banks, activities in upland areas, or activities in upstream seasonal drainages. Exposed, unprotected soil has the potential to erode into aquatic systems, particularly with the season's first significant rain or during overland flows following snowmelt. One study found reduced amphibian densities in streams following road construction (Brown *et al.* 2014), and other studies have demonstrated impacts to fish, macroinvertebrates, and periphyton (Power 1990; Newcombe and MacDonald 1991; Brown *et al.* 2014). Sedimentation can affect all life history stages of the three listed amphibians by altering their habitat (Brown *et al.* 2014). High levels of sediment may fill deep pools used by mountain yellow-legged frogs, and the shallow pools in meadows used by Yosemite toads, alter primary productivity, fill interstitial spaces in stream and lake bed materials with fine particulates, change flow characteristics, reduce dissolved oxygen, and restrict waste removal (Chapman 1988). Embedded substrate potentially reduces the amount and quality of refugia. Conversely, increased amounts of silt substrate and detritus also may provide cover for tadpoles and post-metamorphic life stages. According to the BA, prescribed fires are expected to be short lived and fire intensity should be low enough to allow some retention of duff layers and riparian vegetation that will prevent soil erosion and expedite recovery

The three listed amphibians may be affected by activities in this Forest program that result in any change to the hydrology of their aquatic habitats. A decrease or elimination of the amount and duration of shallow surface water in meadows could affect breeding by the Yosemite toads; or the decrease or elimination in perennial water utilized by the mountain yellow-legged frog. Prescribed fire and mechanical vegetation removal may benefit the Yosemite toad by removing encroaching conifers which may increase water availability in the meadows with suitable or occupied habitat. Fuels and vegetation management may benefit the toad through the reduction of high intensity wildfire and its effects on hydrology and stream sediment.

The S&Gs and BMPs, when properly implemented, and coupled with site-specific conservation measures, will minimize the adverse effects to the three listed amphibian species resulting from the Timber Harvest, Vegetation Management, and Watershed Restoration Program through restrictions in the timing or use of equipment; size and shape of harvest units; emergency response plans for chemical spills; enhancement of native vegetation; stream restoration, and other activities described in the conservation measures of this programmatic biological opinion.

2. <u>Road and Trail Maintenance:</u>
Several characteristics of the three listed amphibians make them vulnerable to effects from roads and trail maintenance. First, these animals move among multiple habitats during their active season which may require crossing roads and trails; second, they move slowly and thus cannot easily avoid maintenance vehicles or equipment; third, they are relatively small and hard to see which makes them difficult to avoid; and fourth, they have permeable skin which may make them more susceptible to the toxic effects of chemicals from vehicles or used for road maintenance (Andrews *et al.* 2008). Potential adverse effects from motorized and non-motorized road and trail maintenance near or within occupied or suitable habitat include harassment, injury and death of the animals.

Drafting of water for road and trail maintenance may result in adverse effects to aquatic habitat. In-stream water drafting can substantially affect water flow or configuration of the bed, bank, or channel of streams that results in rapid changes or sustained reductions in flow, reduced

dissolved oxygen, and/or increased water temperatures which could affect the three listed amphibians. In addition to direct hydro-geomorphic impacts to the mountain yellow-legged frog, water-quality impacts can occur as a result of road approaches that access the water drafting site. Many water drafting sites have steep approaches and in the absence of adequate drainage or surfacing, these approaches can become chronic sources of sediment and runoff to the channel. Vehicles can leak oil, and sometimes fuel, onto drafting pads, becoming a source of petroleum product contamination to surface waters.

Chemical pollutants leaking or spilling from road maintenance may affect the three listed amphibians. Vehicle emissions, oil and gas leaks or spills, road degradation by-products, and chemicals used during road and trail maintenance can enter occupied or suitable habitat. The adverse effects of these pollutants to amphibians include reduced survival, growth, and metamorphosis, altered physiology and behaviors, deformities in tadpole oral cavities, and elevated levels of stress hormones (Mahaney 1994; Lefcort *et al.* 1997; Brown *et al.* 2009, Brown *et al.* 2014; Andrews *et al.* 2008; Beebee 2013).

Road and trail maintenance may result in increased sedimentation levels. Higher levels of sedimentation in aquatic habitat utilized by the three listed amphibians (Brown *et al.* 2009; Brown *et al.* 2014) likely will result in adverse effects to these animals.

When the S&Gs and BMPs are properly implemented, coupled with site-specific conservation measures, will minimize the adverse effects to the three listed amphibian species resulting from the Road and Trail Maintenance Program through water quality monitoring and protection; minimization of erosion; and other activities described in the conservation measures of this programmatic biological opinion.

3. <u>Recreation and Forest Service Infrastructure:</u>

Recreation

The Sierra Nevada yellow-legged frog, Northern Distinct Population Segment of the mountain yellow-legged frog, and the Yosemite toad may be adversely affected by recreational activities. The three listed amphibians are cryptic, relative small animals who may exhibit an immobilization response to danger, which makes it difficult for hikers, fishermen, or other people to avoid them (Mazerolle *et al.* 2005, Andrews *et al.* 2008). The Yosemite toad tends to walk slowly and thus cannot easily or quickly enough avoid danger, whereas mountain yellow-legged frogs can quickly leap to avoid intruders or predators. Adults of the Yosemite toad, and to a smaller extent, the mountain yellow-legged frog move among multiple habitats during their active season and also may encounter recreational activities away from aquatic habitats. Harassment, injury, or death of the three listed amphibians could result from trampling by humans, pack stock, horses or bicycles; maintenance, management or operation of developed recreation sites; activities associated with dispersed recreation such as hiking, camping, fishing, washing, or horseback riding; handling or capture of individuals for pets or collections; humans and domestic dogs playing in lakes, streams, wet areas in meadows or upland suitable or occupied habitat habitats; or changes in water quality and sedimentation impacts at and downstream of recreational activities.

Examples of direct mortality, injury or harassment related to recreational activities include documented observations of trampling of mountain yellow-legged frog larvae and juvenile frogs by pack stock (Brown *et al.* 2009, Brown *et al.* 2014); observations of children and dogs playing in

Yosemite toad breeding sites (BA); trampling, handling, and other disturbance of western toad, which is closely related to the Yosemite toad, egg masses, tadpoles, and metamorphs by anglers, hikers, and their pets at a site in Oregon (USFS 2014); and crushed Yosemite toad adults on the road into a popular campground on the Stanislaus National Forest (Brown *et al.* 2009, Brown *et al.* 2014). Yosemite toads have been found on hiking trails, under campfire rings in remote areas being actively decommissioned and in burrows associated with rocks that line roads to developed campsites (USFS 2014). Yosemite toads have been observed halting trilling during breeding season when vehicles drove by an active breeding site in a high elevation meadow BA potentially modifying breeding behavior. One observation indicates that Yosemite toads may be collected for sale in the pet trade (Brown *et al.* 2009). Rodríguez-Prieto and Fernández-Juricic (2005) found that Iberian frog abundance decreased with proximity to recreational activities and that the time frogs spent in refugia was affected by the amount of human activity that suggests these effects are possible for the three amphibian species.

Recreational fishing is the primary justification for fish stocking in the Sierra Nevada. Predatory fish in alpine lakes where they were historically absent has resulted in the extirpation of the mountain yellow-legged frog from numerous locations. Activities associated with recreational fishing may pose a risk to all three listed amphibians. Diseases may be transmitted by introduced fish, or by fishing lines, lures, and waders, boots, and other equipment. Yosemite toads, including tadpoles, have been used as bait (Brown *et al.* 2009), and this may occur with mountain yellow-legged frogs as well. Wading along stream or lake shores to fish may disrupt, injure or kill early life history stages, modify habitat or change the composition of the habitat. Trailing to streams and lakes may alter riparian vegetation, channelize run-off or affect shoreline stability.

Recreational activities may affect water quality in suitable or occupied habitat. Pollution from operations and use associated with developed recreation areas including ski areas may enter aquatic habitats. Camp-related activities such as swimming and washing may introduce pollutants such as soap, sunscreen and insect repellent into waters used by the three frog species. Several compounds frequently used in sunscreens pose some risk, primarily via their estrogenic activity, to tested lab animals (Schlumpf *et al.* 2001). Wastes from humans and pack animals may introduce other water pollutants such as nitrogen, which can result in algal blooms, decreased oxygen content, and increased water temperatures affecting egg and larval life stages and other stages. Increase siltation, sediment loading, or even nutrients may result from bank erosion caused by day users, hikers, or pack stock,. The effects of increased sedimentation have been documented for stream-dwelling fish, macroinvertebrates, and periphyton (Power 1990, Newcombe and MacDonald 1991; Brown *et al.* 2009, Brown *et al.* 2014).

Generally, studies of the impact of recreational use, specifically camping, in designated wilderness and national parklands in the western United States have found that recreation creates considerable impact rapidly with light use, whereas recovery occurs only after lengthy periods of no use (Cole and Fichtler 1983; Cole 1986; Stohlgren and Parsons 1986; Cole and Marion 1988). Establishment of trails and camps disturbs vegetation and soil structure, resulting in changes in habitat structure and microclimate (Garton *et al.* 1977; Boyle and Samson 1985, Knight and Cole 1991). These activities as well as dispersed camping and other activities that occur near high-elevation meadows, ponds, lakes, and streams can result in increases in erosion and sedimentation, bank trampling, and vegetation disturbance. Heavy recreational use can mimic damage to vegetation and soils caused by overgrazing (Obedzinski *et al.* 2001). Three

wilderness areas studied in the western United States concluded that the impacts on campsites used for less than 10 nights per year had already reached a threshold beyond which further increases in use had little effect on the severity of impacts. These impacts included loss of vegetation cover, soil compaction resulting in slowed infiltration rates, and pronounced increases in soil pH, organic matter content, and nutrient content (Cole and Fichtler 1983).

Horses and mules used as pack stock may adversely affect the three listed amphibians through harassment, injury, death, and harm through overgrazing or pollution of riparian and meadow habitat if they utilize these areas for inappropriate times or amount of time. Commercial pack stock trips are permitted in National Forests within the Sierra Nevada, often providing transport services into wilderness areas. Use of pack stock in the Sierra Nevada increased after World War II as road access, leisure time, and disposable income increased (Menke *et al.* 1996). Since the mid-1970s, National Forests have generally implemented regulations to manage visitor use and group sizes, including measures to reduce pack stock impacts to vegetation and soils in order to protect wilderness resources.

Pack stock use likely is a threat of low significance to the three listed amphibians at the current time, except on a limited, site-specific basis. As California's human population increases, the impact of recreational activities, including pack stock use and riding on the National Forests in the Sierra Nevada, are projected to increase (USFS 2001a). However, on the Inyo National Forest, current commercial pack stock use is approximately 27 percent of the level of use in the 1980s reflecting a decline in the public's need and demand for pack stock trips. From 2001 to 2005, commercial pack stock outfitters within the Golden Trout and South Sierra Wilderness Areas averaged 28 percent of their current authorized use (Forest Service 2006). Habitat changes due to pack stock grazing may pose a risk to some remnant populations of frogs and, in certain circumstances, a hindrance to recovery of populations in heavily used areas.

There are several studies that examined the effects of recreational pack stock grazing on alpine meadow habitat (Olson-Rutz *et al.* 1996a, 1996b, Moore *et al.* 2000, Cole *et al.* 2004). Olson-Rutz *et al.* (1996a, 1996b) found that decreased cover and increased bare soil were correlated with grazing intensity and duration. Pack stock camps in the Bob Marshall Wilderness of Montana exhibited large areas of bare ground, increased soil compaction, and slower rates of water infiltration (Cole and Fichtler 1983). A study comparing three types of meadows in Yosemite National Park with grazed versus ungrazed reference areas found significant changes in meadow structure resulting from horse and mule pack stock grazing after four years (Moore *et al.* 2000; Cole *et al.* 2004). Notably, bare ground increased and productivity declined, and species composition changed on all three meadow types after two years. Plant foliar cover decreased after three years in the wettest of the three meadow types. No change in species richness was observed, but those changes often require longer than four years (Moore *et al.* 2000). Moore *et al.* (2000) also found that leaving 50 percent of biomass at the end of the grazing period to maintain nutrient levels after decomposition resulted in an over 25 percent decline in productivity over the study period on all three meadow types.

Recreational activities may alter the hydrology of lakes, meadows, and creek or stream habitats potentially resulting in their degradation or drying. Recreational infrastructures such as developed campgrounds and dispersed activities such as hiking, camping, or pack stock can compact soil, increase runoff and erosion, alter vegetation, modify pool mudflats, and trample stream banks and lakeshores. These effects can divert water, result in downcutting, and lower

water tables. These effects may result in a reduction or elimination of occupied or suitable habitat. Yosemite toads breed in very shallow water habitats within meadows or lakes and a certain amount of mortality of eggs and tadpoles occurs naturally from desiccation and freezing. Given this natural vulnerability, any changes that result in decreased amounts and shorter persistence of the species' preferred shallow water breeding habitats may reduce reproductive success and recruitment, and ultimately the persistence of populations. Mountain yellow-legged frogs are highly aquatic, require perennial water for their multi-year tadpole stage, and generally require water that does not freeze to the bottom in winter or completely dry during the summer. Thus for these species, hydrological changes that result in shallower water or desiccation may reduce reproductive success and recruitment, survival of all life stages, and ultimately the persistence of populations. Shallower aquatic systems such as those found in wet meadows and small streams are more vulnerable to hydrologic impacts than deeper lakes.

The activities associated with maintenance of developed recreation sites and infrastructure may cause erosion that can increase siltation and sedimentation. Sedimentation can adversely affect the amount or quality of suitable or occupied aquatic habitat (Brown *et al.* 2009; Brown *et al.* 2014). These activities may result in a decrease in vegetative cover along stream and lake shores and in meadows and dislodge rocks, wood and other cover utilized by the three listed amphibians. Rodent burrows, rocks logs, or tree stumps used by the Yosemite toad as refugia may be crushed, moved, or altered. Alterations to cover may increase the risk of predation, change microclimates which can affect growth and survival, and influence prey availability by changing the prey's habitat (Brown *et al.* 2009). Numerous conservation measures that protect riparian vegetation, wetlands and other aquatic features will minimize the adverse effects to the three listed amphibian species

Administrative Infrastructure:
The routine use and maintenance of existing Forest Service facilities is not likely to cause further loss of suitable and occupied habitat but may affect cover, hydrology, water quality, and sedimentation in surrounding areas, or result in the harassment, injury, and death of the three listed amphibians. For example, associated road traffic may increase the risk of individuals being run over by vehicles. These areas tend to have high levels of human activity which may result in harassment caused by the higher levels of general disturbance including noise, vibration, and light.

The clearing of vegetation as part of routine maintenance is likely to have minimal effect on aquatic habitats, but may affect adult Yosemite toads if they use facility surroundings. Equipment and human activity associated with vegetation clearing and other routine maintenance also may destroy or alter cover components such as burrows, logs, tree roots, or stumps.

The routine use and maintenance of facilities may affect the availability and quality of water in suitable or occupied habitats. For example, water may be diverted or used for purposes such as drinking water. Water storage facilities may serve as habitat for invasive species such as bullfrogs or crayfish. Water quality may be affected by Special Use Permit activities associated with existing infrastructures such as campgrounds, work centers, and ski areas. Camp-related activities such as swimming and washing may introduce pollutants such as sunscreen and insect repellent into aquatic habitats. Roads, parking lots, and other paved or compacted surfaces may lead to increased runoff altering hydrology which may ultimately affect water availability and

duration in nearby aquatic habitats. Other potential sources of pollution include sanitation facilities, snowmelt runoff from ski areas, and the use of pesticides for weed control.

Routine use and maintenance of Forest Service facilities also may contribute to increased sedimentation in nearby aquatic habitats. Sedimentation can alter the morphology of habitats, such as filling in pools in streams and creeks, and reduce cover by filling interstitial spaces in stream, creek, and lake substrates.

The S&Gs and BMPs, when properly implemented, and coupled with site-specific conservation measures, will minimize the adverse effects to the three listed amphibian species resulting from the Developed Recreation and Administrative Infrastructure Program through protection of water quality, including stream flows, and the hydrology of wetlands and meadows, as described in the conservation measures of this programmatic biological opinion.

4. Special Use Permits:
Special Use Permits cover a wide array of activities from single occurrence recreation events to construction and maintenance of permanent structures such as maintenance yards, storage facilities, or recreation camps. Many activities requiring special use permits that occur in or near occupied or suitable habitat have the potential to capture, harm, harass, injure, or kill one or more of the three listed amphibians. Temporary uses such as special events may result in short-term trampling that may result in harassment, injury, or death, and the destruction of vegetation, burrows, and other cover components could result in harm. Other special use activities such as clearing of vegetation for routine maintenance of infrastructures including right of ways and transmission lines may result in permanent loss of suitable or occupied habitat.

Some activities authorized by Special Use Permit may alter habitats including cover, hydrology, water quality, and sedimentation. Special uses involving water developments such as dams, diversions, and impoundments can change aquatic habitats. Flooding of meadow and stream habitats can eliminate Yosemite toad and mountain yellow-legged frog breeding habitats. Creation of ponds and lakes can be beneficial for mountain yellow-legged frogs if these habitats are properly designed and constructed, not stocked with fish, or invaded by other non-native species.

Water may be diverted under Special Use Permits for a number of purposes including hydroelectric generation, drinking water, or water storage. Water diversions can adversely affect the three listed amphibians if they remove water from occupied or suitable habitats or shorten the length of time surface water is present. Alteration in the amount and duration of surface water habitat can lead to reduction or failure of successful breeding. The Yosemite toad breeds in very shallow water, and its eggs and tadpoles desiccate and die when water dries up (Kagarise Sherman and Morton 1984; Brown *et al.* 2012). Mountain yellow-legged frogs require permanent water for their multi-year tadpole stage, and multiple year classes may be lost if breeding sites dry out (Lacan *et al.* 2008). Artificially low water levels in a pond or lake going into winter can lead to freezing of the entire water body or reduced oxygen levels, resulting in increased mountain yellow-legged frog mortality (Bradford 1983). Artificial changes in water flows and velocities in creeks or streams during breeding, egg laying, and development can result in injury and mortality to individuals of the two listed frogs.

Water quality may be affected by activities authorized under Special Use permits, such as those that involve infrastructures used by humans including campgrounds, camps, visitor centers, ski areas, roads and other paved surfaces, and other facilities requiring maintenance that are located near water including transmission towers and rights of way. The construction or maintenance of roads, parking lots, and other paved or compacted surfaces may lead to diverted or increased runoff that alters hydrology. This may ultimately affect water availability and duration in nearby aquatic areas that provide occupied or suitable habitat. Recreation-related activities such as swimming and washing may introduce pollutants such as sunscreen and insect repellent into aquatic habitats. Pollution may result from sanitation facilities, water runoff from roads and parking lots, oil and other toxic residue from maintenance equipment, snowmelt runoff from ski areas, and the use of pesticides.

Various activities covered by Special Use Permits may contribute to increased sedimentation in nearby aquatic habitat. Some amount of soil erosion may enter streams with activities that occur within riparian areas. Sediment also may enter waterways from actions requiring ground-disturbing machinery. Sedimentation can alter the morphology of habitats such as by filling in pools in streams, and reduce cover by filling interstitial spaces in stream and lake substrates.

The S&Gs and BMPs properly implemented, coupled with site-specific conservation measures, will minimize the adverse effects to the three listed amphibian species resulting from the Special Use Permit Program through protection of water quality, including stream flows, and the hydrology of wetlands, fens, and meadows, as described in the conservation measures of this programmatic biological opinion.

5. Rangeland Management:
Livestock grazing occurs in riparian and meadow ecosystems on National Forests lands in the Sierra Nevada. Riparian and meadow systems are the key livestock forage areas within allotments above 4,000-foot elevations. Ranchers move livestock to these higher elevation areas during the summer and early fall when the lower elevation ranges dry out (USFS 2001b). Currently, grazing occurs on about 65 percent of the land within 9 Forests (USFS 2001b, 2003; Belsky *et al.* 1999). Sheep grazing only occurs on the Inyo, Plumas, and Tahoe National Forests.

In the Sierra Nevada, several studies have examined associations between livestock grazing and the Yosemite toad (McIlroy *et al.* 2013; Roche *et al.* 2012a, 2012b), and no studies have been conducted for the mountain yellow-legged frog. In their 4 -5 year study from 2006 to 2010, comparing three grazing treatments, 1) utilization at current standards (40 percent), 2) fencing the whole meadow, and 3) fencing breeding areas, McIlroy *et al.* (2013) found no significant detectable differences of the grazing treatments on proportion of occupied Yosemite toad breeding pools, tadpole density, and young of the year density in breeding habitats. Similarly, Roche *et al.* (2012b) found that between 2006-2008, direct effects between Yosemite toad occupancy and livestock utilization in breeding meadows were not significant. Both studies found Yosemite toad occupancy to be associated with meadow wetness. Lind *et al.* (2011) reported high variation in Yosemite toad tadpole and young of the year densities that were strongly influenced by water year type and meadow wetness. Densities were negatively correlated with livestock utilization and depth to water table (Lind *et al.* 2011). Statistically significant negative relationships for tadpole density and grazing intensity (tadpole densities decreased when percent use exceeded between 30 and 40 percent) were reported by Lind *et al.* (2011).

Other studies have found positive, negative, and no association between livestock grazing and amphibians, though most were not conducted in alpine meadows (Adams *et al.* 2009; Bull and Hayes 2000; Burton *et al.* 2009; Ford *et al.* 2013; Jansen and Healey 2003; Knutsen *et al.* 2004). Adams *et al.* (2009) and Bull and Hayes (2000) found no association between various metrics of reproductive success of the Columbia spotted frog and livestock grazing in human-created and natural ponds in northeastern Oregon. Jansen and Healey (2003) found higher amphibian species diversity in low intensity grazed wetlands compared with high intensity grazed wetlands in the Murrumbidgee River floodplains in Australia. Schmutzer *et al.* (2008) found higher species diversity in ungrazed compared with grazed farm ponds on the Cumberland Plateau, Tennessee. Thus, the available literature suggests that the effects of livestock grazing on individuals, populations, and community structure may be variable and there is considerable variability in the responses of different amphibian species. Ecosystem type (e.g., low elevation grasslands, high alpine meadows) may play a role in this variation. Further complicating the ability to distinguish a species' response to livestock grazing is the fact that livestock-related impacts vary significantly in terms of timing, intensity, and duration on an annual basis and many of the processes related to livestock effects on aquatic habitats are long-term.

The Yosemite toad and mountain yellow-legged frog spend all or part of their life in aquatic and meadow systems that also are preferred by livestock (e.g., Vredenburg *et al.* 2005;Allen-Diaz *et al.* 2010 in USFS 2012). Yosemite toads may be exposed to livestock effects in their upland habitats. The three listed amphibians have biological and ecological characteristics that make them vulnerable to livestock and associated activities. In general, they are small, cryptic, move relatively slowly, and often exhibit an immobilization response to danger (Mazerolle *et al.* 2005; Andrews *et al.* 2008). These amphibians move among multiple habitats during their active season and may encounter livestock and associated activities away from aquatic habitats.

Yosemite toads may be injured or killed by trampling and other movements by cattle, entrapment in deep hoof prints or other disturbance. Cattle can step on adults, subadults, metamorphs, and tadpoles while in meadow, terrestrial or sheltering habitat (e.g., burrows, logs, stumps) resulting in injury or death. Eggs and tadpoles have potentially high risk of trampling since these stages have no or low mobility and are often found in very small shallow pools with few escape options. However, the effective implementation of S&G 53 would eliminate the risk for eggs and tadpoles by excluding cattle from breeding areas until after tadpoles metamorphose.

Adult and subadult Yosemite toads also are vulnerable because they are, in general, poor hoppers with low mobility, have an immobilization response to threats, and thus cannot quickly move out of the way of cattle. Recent metamorphs are extremely small (< 1 inch) with very limited escape abilities. The risk of trampling of large numbers of metamorphs is highest if cattle are present during the metamorphosis period when they are concentrated at breeding areas; metamorphs eventually disperse into meadows and uplands. Similarly, outside of the breeding period, adults and subadults generally are dispersed in upland habitats or in meadows. The risk of coming in contact with cattle for all life stages is highest in meadows or near the direct perimeter of meadows. In the Bull Creek Watershed on the Sierra National Forest, Liang (2010) monitored several adults that utilized rodent burrows throughout the summer within 75 feet of a meadow. During a 2-year study in Tioga Pass Meadow, Morton and Pereyra (2010) found 58 percent of 654 adult and subadult toads in the meadow bottoms rather than in upland areas, although adult males comprised the largest component of this group. Females were predominately found in uplands away from meadows. The impacts from upland grazing on

individuals in upland habitats are currently unknown. When disturbed while basking at the edge of rodent burrows, Yosemite toad adults and subadults tend to retreat a short distance into the burrow and come back up to the surface in a short amount of time, potentially increasing their risk of being stepped on by nearby cattle. Trampling of rodent burrows used for seasonal or overwintering refuge potentially may crush or injure individuals or trap them underground permanently.

Mountain yellow-legged frogs also may be injured or killed by trampling and other movements by cattle, or entrapment in deep hoof prints. Cattle can step on adults, juveniles metamorphs, and tadpoles while accessing water along streambanks, lakeshores, or meadows, or while foraging for riparian vegetation in these habitats which can result in injury or death. Although eggs are most vulnerable to trampling and disturbance, cattle are not usually present during this period. Mountain yellow-legged frog tadpoles, subadults, and adults are relatively more mobile than Yosemite toads, and generally occur in habitats with more continuous and deeper water that provides more avenues for escape. Tadpoles will rapidly swim away to deeper water in lakes or stream channels. Adults and subadults will leap from the shoreline and submerge themselves under water to hide under stream banks or on the bottom of the lake or stream. However, all life stages commonly bask on shallow shorelines or on stream and lake banks, and are vulnerable to trampling by cattle utilizing these occupied habitats to drink water, cross through habitats (e.g. streams), or forage on emergent or shoreline vegetation.

Activities associated with management of allotments also may affect Yosemite toads and mountain yellow-legged frogs. These activities include maintenance of allotment structures (e.g., fences, corrals, permanent and temporary camps), herding or monitoring individuals by foot or horseback, keeping of horses in meadows, maintenance of stock trails, and the operation of vehicles to support allotment operations. The Yosemite toad may be more vulnerable to these activities than the more aquatic mountain yellow-legged frog because it uses meadow and upland habitats away from water. Similar to those described for livestock above, these activities may injure or kill individuals by trampling, crush or collapse Yosemite toad burrows with the result of entrapment or mortality, or affect behavior through disturbance.

Various rangeland management practices that are associated with the management of allotments may reduce the likelihood of potential effects to Yosemite toads and mountain yellow-legged frogs. For instance, grazing systems, forage utilization and streambank alteration standards can influence the amount of time that livestock are allowed to linger in a particular area. Range improvements like fences, water developments, and salting as well as other techniques like herding may be used to distribute livestock away from areas where interactions with amphibians are more likely to occur. New facilities may be constructed outside of meadows and conservation areas where the likelihood of potential effects on individuals may be greater.

Grazing has the potential to reduce the suitability of habitat for the mountain yellow-legged frog by reducing its capability to sustain individuals and facilitate dispersal and migration, especially in stream areas. Grazing of livestock in riparian areas impacts the function of the aquatic system in multiple ways, including soil compaction, which increases runoff and decreases water availability to plants; vegetation removal, which promotes increased soil temperatures and evaporation rates at the soil surface; and direct physical damage to the vegetation (Kauffman and Krueger 1984; Cole and Landres 1996; Knapp and Matthews 2002). Streamside vegetation protects and

stabilizes streambanks by binding soils to resist erosion and trap sediment (Kauffman *et al.*1983; Chaney *et al.* 1990).

Grazing within mountain yellow-legged frog habitat has been observed to remove vegetative cover, potentially exposing frogs to predation and increased desiccation (Knapp 2005b; Jennings 1996), and to lead to erosion which may silt in ponds and thereby reduce the water depth needed for overwinter survival (Knapp 2005b). An appropriately managed grazing regime, including timing and intensity, can enhance primary riparian vegetation attributes that are strongly correlated to stream channel and riparian soil stability conditions necessary to maintain a functioning riparian system. Although, where highly degraded conditions such as downcut channels exist, grazing management alone may not be sufficient to restore former riparian conditions.

Aquatic habitat can be degraded by livestock grazing. Mass erosion from trampling and hoof slide causes streambank collapse and an accelerated rate of soil transport to streams (Meehan and Platts 1978). Accelerated rates of erosion lead to elevated instream sediment loads and depositions, and changes in stream-channel morphology (Meehan and Platts 1978; Kauffman and Krueger 1984). Livestock grazing may lead to diminished perennial streamflows (Armour *et al.*1994). Livestock can increase nutrient-loading in water bodies due to urination and defecation in or near the water, and can cause elevated bacteria levels in areas where cattle are concentrated (Meehan and Platts 1978; Kauffman and Krueger 1984). With increased grazing intensity, these adverse effects to the aquatic ecosystem increase proportionately (Meehan and Platts 1978; Clary and Kinney 2000). Observational data indicate that livestock can negatively impact mountain yellow-legged frogs by altering riparian habitat (Knapp 2005b). Livestock tend to concentrate along streams and wet areas where there is water and herbaceous vegetation; grazing impacts are, therefore, most pronounced in these habitats (Meehan and Platts 1978; Fleischner 1994; Menke *et al.*1996). Concentration of livestock contributes to the destabilization of streambanks, causing undercuts and bank failures (Kauffman *et al.*1983; Marlow and Pogacnik 1985; Knapp and Matthews 2000a; Moyle *et al.* 1996).

Livestock grazing and associated activities may alter the hydrology of meadows, streams, and other aquatic habitats used by the listed amphibians. Livestock grazing may affect multiple interrelated processes that may ultimately result in less available aquatic habitat that dries more quickly during the summer. Heavy trampling by livestock can compact soils which may reduce the infiltration of overland flows and precipitation. Reduced infiltration and increased runoff may decrease the recharge of the saturated zone in meadow and riparian habitats (Platts 1990 in USFS 2003). Livestock grazing can reduce the abundance of protective vegetation, destroy peat layers in meadows, and accelerate streambank erosion which can lead to downcutting of stream channels and lowered water tables (USFS 2003; Service 2013). Downcut channels become confined within narrow, incised channels and are no longer connected to their historical, meadow floodplains. As water tables fall in meadows, their water storage capacity lessens, and they become less suitable for riparian vegetation which may be supplanted by drought-tolerant communities. Acceleration of erosion and gullying of meadows resulting from overgrazing (Kattelmann 1996 in Service 2013) may lead to increased siltation and more rapid meadow succession ultimately resulting in faster meadow drying and encroachment of conifers into meadows (Service 2013). In some cases, formerly perennial streams may become intermittent (Service 2013). These interrelated processes which result in lowered water tables, reduced inundation of flood plains, and faster drying can lead to reduced amounts of surface water that

may not remain for sufficient time periods to provide for the ecological requirements of the three listed amphibians.

The wet soil associated with aquatic habitats such as wet meadows, lake shores, and streambanks are particularly vulnerable to trampling by livestock (Marlow and Pogacnik 1985 in Brown *et al.* 2009; Brown *et al.* 2014). Livestock trampling may alter the shallow breeding areas used by the Yosemite toad or the shallow shoreline microhabitats in lakes and streams preferred by the mountain yellow-legged frog and the Yosemite toad. Pock-marking and soil compaction can result from cattle walking in and trailing through breeding sites in wet meadows, stream crossings, and lakeshores. Pock-marks can isolate Yosemite toad tadpoles into smaller pools as meadows dry (USFS 2012) and inhibit metamorph movements. Pock-marks can be moderated by natural freeze and thaw cycles over a period of 5-10 years when rested from grazing (USFS 2014; Menke *et al.* 1996; USFS 2012).

Livestock can modify shoreline habitats by trampling overhanging banks that provide cover for individuals and may contribute to the siltation of breeding pools which may reduce depths making the pools less suitable or unsuitable as breeding habitats for the three species, or as overwintering habitat for mountain yellow-legged frogs (Service 2013). Livestock trampling and erosion may result in progressively wider and shallower stream channels (USFS 2003). Changes in shoreline topography can alter water temperatures and drying patterns which can affect development rates and survival to metamorphosis; these effects may be positive or negative depending on the circumstances.

Animal wastes could directly impair water quality through bacterial contamination or increasing nutrient levels (EPA 1991; Derlet *et al.* 2006, 2008, 2010 in USFS 2012). Reduction in water quality may compromise immune function by inducing stress thus making larvae more susceptible to pathogens (USFS 2012). Increased nutrient loading may result in delayed metamorphosis or reduced size at metamorphosis (Gerlanc and Kaufman 2005 in USFS 2014). A delay in metamorphosis could make tadpoles more vulnerable to mortality from mid-season (August) desiccation, snowfall or freezing. A reduced size at metamorphosis could affect the fitness of individuals following metamorphosis and prior to overwintering (USFS 2014).

Allen-Diaz *et al.* (2010) found that Yosemite toad occupancy is strongly driven by meadow wetness (hydrology), and suggested that future studies should focus on contemporary factors directly impacting meadow wetness, such as climate, fire regime changes, and conifer encroachment. A positive relationship was found between meadow dryness and livestock use, e.g., cattle prefer drier meadows, and they found that proportion of toad-occupied pools and tadpole and young-of-year densities declined in drier sites, e.g., toads prefer wetter meadows (Lind *et al.* 2011). Lind *et al.* (2011) suggested this has resulted in some segregation of the Yosemite toad and livestock use in meadow habitats. The initial results of Diaz *et al.* (2010) are inconclusive as to the impacts of grazing on Yosemite toad population's rangewide. Diaz *et al.* (2010) did not utilize sufficient statistical power in their analysis that would allow discrimination over time of the treatment effect for longer-lived species with irregular female breeding activity. A time lag may occur between effect and discernable impacts even if monitoring is sufficiently robust to determine population level responses. Significant variation was observed in young-of-year occupancy in pools between meadows and years, and within meadows over years (Allen-Diaz *et al.* 2010). This variability would likely mask treatment effects, unless the grazing variable was a dominant factor driving site occupancy and the magnitude of the effect was quite severe.

The Forest Service grazing guidelines for protection of meadow habitats of the Yosemite toad require fencing of breeding meadows, but they may not provide sufficient protections for upland habitat. Given the observation that livestock grazing significantly reduced vegetation height and Yosemite toad use of grazed meadows, and these areas are unprotected by current grazing guidelines, Martin (2008) deduced that cattle grazing is having a negative effect on terrestrial life stage survivorship. This problem is exacerbated as fenced areas effectively shifted grazing activity to upland areas actively used by terrestrial life stages of the toad (Martin 2008).

The Forest Service will develop and implement a monitoring program in conjunction with the Service to further assess the effectiveness of the Conservation Measures that will includes compliance, their success in minimizing adverse effects to the three listed amphibians, and appropriate modifications or changes to minimize the effects.

The S&Gs and BMPs when properly implemented, coupled with site-specific conservation measures, will minimize the adverse effects to the three listed amphibian species resulting from the Range Management Program through protection of water quality; seasonal restrictions; and other activities as described in the conservation measures of this programmatic biological opinion.

6. Biological Resources Management:
This Biological Resources Management program likely will result in long term beneficial effects for the three listed amphibians, however, it likely that there will be short-term adverse effects. Survey and monitoring, along with associated handling and marking of individuals, and enhancement of habitat may result in short-term disturbance and/or harassment and, rarely, inadvertent injury or death of individual animals. Marking, attaching radios, or swabbing for chytrid fungus will result in capture and harassment, and possibly injury or death if conducted by non-Service approved biologists.

The increase in human activity associated with handling, marking, swabbing individuals of the three listed amphibian species, and habitat enhancement or restoration has the potential to spread diseases such as chytrid fungus. Chytrid outbreaks have caused extirpation of populations of mountain yellow-legged frogs, and is one the leading causes of the decline of these species. Human activity associated with surveys and habitat work has the potential to attract predators such as corvids (Olson 1989, Kagarise Sherman and Morton 1993), which under normal circumstances, may not have been alerted or noticed the presence of the listed species.

Certain restoration activities designed and intended for other purposes have the potential to indirectly adversely affect the three listed species. Projects may that eliminate or reduce pooling of surface water, such as the removal of user-created dams, could result in the desiccation of tadpoles and egg masses leading to injury, death and the loss of recruitment. Removal of barriers to fish passage, e.g., the creation or enhancement for the passage of aquatic organisms, can facilitate the invasion of predatory fish, including trout, into areas where they had previously not inhabited or from which they have been eradicated. Restoration activities that create ponded water may create additional habitat for the three listed species, but also may benefit American bullfrogs, predatory fish, or other nonnative species (Brown *et al.* 2014). American

bullfrogs and other exotic species, such as non-native crayfish, have an adverse effect because they are predators on other related ranids.

Harassment, harm, injury, or death of the three listed amphibians could result from activities intended to restore, protect, maintain, or improve aquatic and riparian habitats, such as the restoration of streams and meadows, prevention of lodgepole encroachment, planting, blocking/disguising unauthorized vehicle or trail routes, fencing, and the removal of trash, etc. However, these projects are designed to improve habitats, and the long-term benefits to the three listed amphibians likely will outweigh the initial short-term adverse effects. For example, meadow restoration that increases water tables and the connectivity of water to floodplains is likely to increase the amount and duration of occupied or suitable habitat.

The S&Gs and BMPs when properly implemented, coupled with site-specific conservation measures, will minimize the adverse effects to the three listed amphibian species resulting from the Biological Resource Management Program through restriction of the use of wheeled vehicles and chemicals; storage of fuel and other toxic materials outside of riparian habitat; and other activities as described in the conservation measures of this programmatic biological opinion.

7. Invasive Species Management:
The invasive species management program likely will result in initial short-term adverse effects to the three listed amphibians in the form of harm, harassment, injury, and death. Invasive species management could result in harm through changes in water quality and sedimentation at and downstream of areas of activities.

Nonnative fish species within alpine lakes are removed to restore habitat for the mountain yellow-legged frog. Fish removal is a highly effective restoration tool with well-documented benefits (Vredenburg 2004; Knapp *et al.* 2007). Potential short-term adverse effects include harassment, capture, injury, and death when gill nets are deployed, retrieved or operated. The increase in human activity associated with the removal of predatory fish with gill nets or electro-fishery equipment has the potential to spread diseases such as chytrid fungus. Chytrid outbreaks have caused extirpation of populations of mountain yellow-legged frogs, and is one the leading causes of the decline of these species. Human activity associated with fish removal has the potential to attract predators such as ravens, blackbirds, and Clark's nutcrackers (Olson 1989, Kagarise Sherman and Morton 1993), who under normal circumstances, may not have been alerted or noticed the presence of the listed species.

The physical removal of non-native or undesirable plants may result in harm, harassment, injury and death caused by the disturbance and trampling of native riparian vegetation trampling of streambanks and shorelines, heavy equipment, and increased sedimentation. However, physical removal and control of non-native plants or unwanted plant growth, such as lodgepole pine invasion of alpine meadows, will be a beneficial effect to the three listed amphibians by allowing native vegetation to recover, and eliminate or slow the unwanted expansion of vegetative growth into suitable and occupied habitats, especially mountain meadows.

The S&Gs and BMPs when properly implemented, coupled with site-specific conservation measures, will minimize the adverse effects to the three listed amphibian species resulting from the Invasive Species Management Program through restriction of the use of wheeled vehicles

and chemicals; storage of fuel and other toxic materials outside of riparian habitat; and other activities as described in the conservation measures of this programmatic biological opinion.

8. Mining:
Most mining in the Sierra Nevada is in the westside foothills and east of the range in Inyo County, outside the boundaries of most National Forests (USFS 2001b). The majority of these areas are below the ranges of the two frog species; however, mining activities may affect the Sierra Nevada yellow-legged frog on the Plumas National Forest. Mining is one of the historical activities that have had some of the most significant impacts on Sierra Nevada streams (USFS 2001b).

The intensity and extent of the adverse effects of mining on the three listed amphibians depend on the mining technology employed, extent of disturbance, chemical and physical composition of the mineral, surface and subsurface hydrologic pattern, and method of reclamation (Harvey and Lisle 1998; Haugen and Duff 1982; Ott 1985; Nelson *et al.* 1991). The potential effects from mining in or near occupied or suitable habitats of the three amphibian species include harm, harassment, capture, injury, and death as a result of human or mechanical activities. Harassment may result from actual mining, reclamation activities, or from the increased presence of humans. This may alter the behavior of individuals, including feeding, mating, movement, and resting, potentially resulting in their injury or death.

Suction dredging may capture, harm, harass, injure, or kill trap and kill the three listed amphibians, especially the mountain yellow-legged frog. Increases in sedimentation downstream of suction dredging activities may bury and suffocate eggs and larvae (CDFG 1994, Brown *et al.* 2014).

Mining and associated activities may alter water quality (California States Lands Commission 1993; Larson 1996) for the three listed amphibians. Weathering and erosion of rock exposed by mining can potentially increase pollutants such as acid, cadmium, mercury, and asbestos in waterways (CSLC 1993), and water can solubilize potentially toxic metals exposed through mining activities (Brown *et al.* 2014). Fuels and other chemical pollutants associated with mining-associated machinery potentially may enter waterways. For example, suction dredging equipment usually is operated in stream channels and fuel spills are possible (USFS 2001a). Chemical pollutants also may enter suitable or occupied habitat from road use, maintenance, and other activities associated with mining. Although the effects of mining-associated toxicity to on the three listed amphibians have not been investigated, they may be particularly vulnerable because of their permeable skin and aquatic life stages.

Mining activities may alter the hydrology of aquatic habitats through water impoundments or diversions, or through changes to stream channel morphology including channel downcutting. Harm to the three listed amphibians could result from activities that alter stream flows or other hydrological processes causing the degradation or elimination of suitable or occupied habitat. In the Sierra Nevada, mining activities affecting aquatic habitats are most prevalent in streams and pose a risk to stream-inhabiting populations of the Sierra Nevada yellow-legged frog and the Northern Distinct Population Segment of the mountain yellow-legged frogs. The creation of ponds or other water impoundments associated with mining may be invaded by predatory non-native species such as bullfrogs or predatory fish that may eat individuals of the three listed amphibians, or serve as a source population for dispersing exotic animals.

Mining activities may cause harm to the three listed amphibians by alteration of available cover in suitable or occupied habitat through the removal of substrate or changing its composition, removal or disturbance of riparian, meadow, or upland vegetation, or by increasing sedimentation. Mining that occurs in the Yosemite toads' suitable or occupied upland habitat may crush or eliminate burrows, important refugia for adults and subadults, or may result in their harassment, capture, injury or death. Riparian vegetation provides an important structural role in streams by stabilizing stream banks. The elimination or degradation of riparian vegetation by mining may increase erosion, sedimentation, and alterations to stream channel morphology. Mining often removes or re-arranges large amounts of substrate. For example, the tailings from suction dredges often form mounds of loose and unconsolidated gravels and cobbles which are easily moved during high flows. Loss of cobble or other medium-sized substrates that frogs use for cover may increase their risk of predation. Increased levels of sediment resulting from mining and associated activities may embed larger substrates which could further reduce available cover for the three listed amphibians. The effect of increased sedimentation on the Sierra Nevada yellow-legged frog, Northern Distinct Population of the mountain yellow-legged frog, and the Yosemite toad has not been investigated, however, studies have shown impacts to fish, macroinvertebrates, periphyton (Power 1990; Newcombe and MacDonald 1991), and at least one study found reduced amphibian densities in streams following road construction (Brown *et al.* 2014). Sedimentation may embed substrate reducing refugia and causing other habitat modifications (Brown *et al.* 2014).

The Sierra Nevada yellow-legged frog, Northern Distinct Population Segment of the mountain yellow-legged frog, and the Yosemite toad require warm water, basking sites, and cover from predators. Changes to microclimates caused by mining activities may affect growth and survival. Reduction of riparian vegetation cover may benefit the three species by increasing the amount of available warm water habitat and basking sites or may adversely affect them if temperatures increase higher than thermal tolerances, or if other cover from predation is not available.

The S&Gs, and BMPs when properly implemented, coupled with site-specific conservation measures, will minimize the adverse effects to the three listed amphibian species resulting from the Mining Program through the withdrawal of critical aquatic refuges for 20 years; protection of hydrology by mine reclamation; limiting new road construction; protection of water quality; and other activities described in the conservation measures of the programmatic biological opinion.

9. Lands and Real Estate:
Most activities associated with major land acquisitions, developments, and reclamation of lands and facilities are considered individual actions with separate project-related NEPA and individual section 7 consultations. The appropriate listed amphibian species likely will benefit when lands are acquired that include their populations and/or suitable habitat.

The S&Gs and BMPs properly implemented, coupled with site-specific conservation measures, will minimize the adverse effects to the three listed amphibian species resulting from the Lands and Real Estate Program through restriction of conducting land surveys and marking of property boundaries by one or two people with specialized equipment as described in the conservation measures of this programmatic biological opinion.

Cumulative Effects

Cumulative effects include the effects of future State, Tribal, local, or private actions that are reasonably certain to occur in the action area. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

Introduced trout are predators of the mountain yellow-legged frog, exclude them from deep alpine lake habitats, increase the isolation of remaining populations, and affect the associated aquatic communities (Bradford 1989; Bradford *et al.* 1993; Finlay and Vredenburg 2007; Knapp and Matthews 2000a, 2000b; Knapp *et al.* 2007; Bahls 1992). In 2010, the California Department of Fish and Wildlife (2011) completed the Hatchery and Stocking Program Environmental Impact Report/Environmental Impact Statement (EIR), which included mitigation measures to reduce or eliminate impacts of hatchery operations and fish stocking on native species, including the mountain yellow-legged frog. A requirement of the EIR is all fish stocking funded by the Federal government that is conducted by the California Department of Fish and Wildlife must be evaluated using the Pre-stocking Evaluation Protocol. Because of stocking changes made in 2000, the EIR did not result in reductions by the State of California to benefit the mountain yellow-legged frog. In addition, the California Department of Fish and Wildlife may implement a Pre-stocking Evaluation Protocol when they have the authority to issue private stocking programs.

Chytrid fungus is an on-going threat to the three listed amphibians. This fungus may have arrived in the Sierra Nevada in the 1960s or 1970s (California Department of Fish and Wildlife 2011; Vredenburg *et al.* 2010) and is now present in most aquatic habitats in this bioregion. At present, few effective measures against chytrid exist, but the development of such interventions is the subject of intensive research (California Department of Fish and Wildlife 2011).

The average temperature in the United States has risen by approximately 1.5° Fahrenheit since 1895; more than 80 percent of this increase has occurred since 1980 (Adger *et al* 2007; Schiermier 2012; Tollefson and Monarstersky 2012; Allen *et al.* 2013; Kadir *et al.* 2013; U.S. Global Research Program 2013; Hurteau *et al.* 2014; Melillo *et al.* 2014; Wright *et al.* 2013; Schiermeier 2012). There is an international scientific consensus that most of the warming observed is the result of human activities (Adger *et al.* 2007; U.S. Global Change Research Program 2013; Merillo *et al.* 2014), and that it is due to increasing concentrations of greenhouse gases, including carbon dioxide, methane, and nitrous oxide, in the global atmosphere from burning fossil fuels and other human activities (Monastersky 2013; Adger *et al.* 2007). The temperatures in the United States will continue to rise, with the next few decades projected to see another 2°F to 4°F of warming in most areas. The amount of warming by the end of this Century is projected to closely correspond to the cumulative global emissions of greenhouse gases up to that time, ranging from 3°F to 10°F depending upon the level of emissions after the year 2050 (U.S. Global Change Research Program 2013). There are multiple mechanisms by which global warming may push already imperiled species closer or over the edge of extinction. Global warming increases the frequency of extreme weather events, such as heat waves, droughts, and storms (California Climate Action Team 2006; U.S. Global Change Research Program 2013). As global temperatures continues to rise, habitats are moving northward and upward in elevation, others will be eliminated, but in the near future, range contractions or extinctions of some species are more likely than simple northward or upslope shifts and this may be especially pronounced for Sierra amphibians owing to habitat fragmentation and the relative lower dispersal ability of these

species. Since climate change threatens to disrupt annual weather patterns, it will result in a loss of habitats, food, or increased numbers of predators, parasites, and diseases.

For the Sierra Nevada ecoregion, climate models predict that mean annual temperatures will increase by 3.2 to 4.3 °F by 2070, including warmer winters with earlier spring snowmelt and higher summer temperatures (Point Reyes Bird Observatory 2011). Additionally, mean annual rainfall is projected during this time period to decrease from the current average by some 3.6–13.3 inches (Point Reyes Bird Observatory 2011). However, projections have high uncertainty and one study predicts the opposite effect (Point Reyes Bird Observatory 2011). Snowpack is, by all projections, going to decrease dramatically following the temperature rise and increase in precipitation falling as rain (Point Reyes Bird Observatory 2011). Higher winter streamflows, earlier runoff, and reduced spring and summer streamflows are projected, with increasing severity in the Sierra Nevada (Point Reyes Bird Observatory 2011). Snow-dominated elevations from 6,560–9,190 feet will be the most sensitive to temperature increases (Point Reyes Bird Observatory 2011). Meadows fed by snowmelt may dry out or be more ephemeral during the non-winter months (Point Reyes Bird Observatory 2011).

The Yosemite toad has a short active season and it requires very shallow ephemeral water for reproduction (Kagarise Sherman and Morton 1984). The amount of water in the breeding ponds is dependent on the amount and timing of the spring snowpack. As snow melts in the spring, meadow breeding areas flood and pools fill with water, and then dry out during the course of the summer. Rapid desiccation of breeding sites can lead to low or no recruitment of the Yosemite toad (Kagarise Sherman 1980). Reductions in snowpack may result in less available surface water, fewer pools for Yosemite toad reproduction and development of early life history stages (Adger *et al.* 2007; McMenamin *et al.* 2008). Low snowpack's also may contribute to increased conifer encroachment of meadow habitat (Service 2014). Rising temperatures and early snowmelt may influence the Yosemite toad's behavior, the timing of reproduction and other phenological events, the duration of tadpole development, and resulting effects on survivorship (Blaustein *et al.* 2010; Walls *et al.* 2013).

The Sierra Nevada yellow-legged frog and the Northern Distinct Population Segment of the mountain yellow-legged frog have short active seasons, overwinter in aquatic habitats for about nine months each year, and require perennial water for reproduction (Bradford 1983, Lacan *et al.* 2008; Pope and Matthews 2001; Zweifel 1955). Reduced snow pack and increased evapotranspiration may result in desiccation of breeding areas, which in turn, may reduce their breeding success (Lacan *et al.* 2008). Rising temperatures and early snowmelt may influence the timing of mountain yellow-legged frog reproduction, and reduce the time available for tadpole development, and adversely affecting on survivorship (Blaustein *et al.* 2010; Walls *et al.* 2013).

Global Climate Change is highly likely to adversely influence ground water transport, reduced persistence of surface water that leads to lower water levels available for eggs, tadpoles, breeding, and other life history stages of the Yosemite toad, Northern Distinct Population Segment of the mountain yellow-legged frog, and Sierra Nevada yellow-legged frog. Therefore, ongoing Global Climate Change is highly likely to imperil these three listed species and the resources, including the aquatic areas, necessary for their survival.

Conclusion

After reviewing the current status of the Sierra Nevada yellow-legged frog, Northern Distinct Population Segment of the mountain yellow-legged frog, and the Yosemite toad, the environmental baseline for the action area, effects of the proposed action, and the cumulative effects, it is the Service's conclusion that the Nine Forest Programs on Nine National Forests in the Sierra Nevada, as proposed, is not likely to jeopardize the continued existence of these three amphibian species. The Service reached this conclusion because for each project appended to this programmatic biological opinion, the Forest Service will fully implement the appropriate Conservation Measures.

PROGRAMMATIC INCIDENTAL TAKE STATEMENT

Section 9(a)(1) of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened fish and wildlife species without special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harass is defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to a listed species by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering. Harm is defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by impairing behavioral patterns including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with this Incidental Take Statement.

The measures described below are non-discretionary, and must be implemented by the Forest Service so that they become binding conditions of any grant, contract, or permit issued by the Forest Service as appropriate, in order for the exemption in section 7(o)(2) to apply. The Forest Service has a continuing duty to regulate the activity covered by this Incidental Take Statement. If the Forest Service: (1) fails to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit, contract, or grant document; and/or (2) fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Forest Service must report the progress of the action and its impact on the Sierra Nevada yellow-legged frog, Northern Distinct Population Segment of the mountain yellow-legged frog, and the Yosemite toad to the Service as specified in the incidental take statement (50 CFR §402.14(i)(3)).

Amount or Extent of Take

The specific amount or extent of incidental take of the Sierra Nevada yellow-legged frog, Northern Distinct Population Segment of the mountain yellow-legged frog, and the, Yosemite toad is unquantifiable at this time because this consultation has analyzed the nine Forest programs in the Sierra Nevada at a programmatic level. The Forest Service will submit individual projects to the Service for specific review and analysis by the Service. If appropriate, incidental take will be authorized upon appendage of the specific project to this programmatic biological opinion. No exemption from section 9 of the Act is granted in this programmatic biological opinion.

Effect of the Take

No incidental take is authorized by this programmatic biological opinion for the the Sierra Nevada yellow-legged frog, Northern Distinct Population Segment of the mountain yellow-legged frog, and the Yosemite toad.

Reasonable and Prudent Measures

1. The Forest Service shall request appropriate specific projects that may adversely affect the Sierra Nevada yellow-legged frog, Northern Distinct Population Segment of the mountain yellow-legged frog, and the Yosemite toad be appended to this programmatic biological opinion.

2. The Forest Service shall minimize adverse effects to the Sierra Nevada yellow-legged frog, Northern Distinct Population Segment of the mountain yellow-legged frog, and the Yosemite toad by implementing the project description as described with the additional terms and conditions below.

3. The Forest Service shall monitor the effects of the Nine Forest Programs on the Sierra Nevada yellow-legged frog, Northern Distinct Population Segment of the mountain yellow-legged frog, and the Yosemite toad.

Terms and Conditions

To be exempt from the prohibitions of section 9 of the Act, the Forest Service must comply with the following terms and conditions, which implements the reasonable and prudent measures described above. These terms and conditions are non-discretionary.

1. The following Term and Condition implements Reasonable and Prudent Measure One (1):

    a. The Forest Service shall ensure each project submitted for appendage to this programmatic biological opinion meets the conditions and requirements in the BA and the project description of this document.

2. The following Term and Condition implements Reasonable and Prudent Measure two (2):

    a. The Forest Service shall implement the conservation measures described within the Biological Assessment and the project description of this programmatic biological opinion.

    b. Tightly woven fiber netting or similar material shall be not used for erosion control or other purposes where the nine Forest programs are implemented within suitable habitat to ensure that the Sierra Nevada yellow-legged frog, Northern Distinct Population Segment of the mountain yellow-legged frog, and Yosemite toad do not get trapped, injured or killed. Plastic mono-filament netting or similar material shall not be used at any of these projects because individuals of these listed species may become entangled or trapped in it.

    c. If appropriate, the Forest Service shall move the Sierra Nevada yellow-legged frog, Northern Distinct Population Segment of the mountain yellow-legged frog, and the Yosemite toad

from within project sites where the nine Forest programs are implemented to a safe location if they are in danger. (See Appendix C of this Programmatic Biological Opinion)

i. Each Sierra Nevada yellow-legged frog, Northern Distinct Population Segment of the mountain yellow-legged frog, and the Yosemite toad encounter shall be treated on a case-by-case, but the general procedure is as follows: (1) leave the non-injured animal alone if it is not in danger; or (2) move the animal to a nearby safe location if it is in danger. These two actions are further described below.

(a) When a Sierra Nevada yellow-legged frog, Northern Distinct Population Segment of the mountain yellow-legged frog, and the Yosemite toad is encountered within the project site, the first priority is to stop all activities in the surrounding area that may have the potential to result in the harassment, injury, or death of the individual. Then, the situation shall be assessed by a Forest Service biologist or Service-approved biologist in order to select a course of action that will minimize adverse effects to the individual.

(b) Avoidance is the preferred option if an individual of the Sierra Nevada yellow-legged frog, Northern Distinct Population Segment of the mountain yellow-legged frog, and/or Yosemite toad is not moving or using a burrow or other refugia. A Forest Service biologist or Service-approved biologist shall inspect the animal and the area to evaluate the necessity of fencing, signage, or other measures to protect the animal.

(c) If appropriate, the, three listed amphibians shall be allowed to move out of the hazardous situation on their own volition to a safe location. An animal shall not be picked up and moved based on it not moving fast enough or it is an inconvenience for activities associated with rehabilitation or operation. This only applies to situations where individuals are encountered when they are moving during conditions that make their upland travel feasible. It does not apply to individuals that are uncovered, exposed, or in areas where there is not sufficient adjacent habitat to support the species should the animal move outside the immediate area.

(d) Individuals of the three listed species shall be captured and moved by hand only when it is necessary to prevent harassment, injury, or death. If suitable habitat is located immediately adjacent to the capture location, then the preferred option is relocation to that site. An individual shall not be moved outside of the radius it would have traveled on its own. Under no circumstances shall they be relocated to a non-Forest Service property without the landowner's written permission.

(e) Only Forest Service biologists or Service-approved biologists may capture the three listed amphibians. Nets or bare hands may be used to capture the animals. Soaps, oils, creams, lotions, repellents, or solvents of any sort cannot be used on hands within two hours before and during periods when the biologist is capturing and relocating individuals. If the animal is held for any length of time in captivity, they shall be kept in a cool, dark, moist environment with proper airflow, such as a clean and disinfected bucket or plastic container with a damp sponge. Containers used for holding or transporting shall not contain any standing water, or objects or chemicals

that may injury or kill a Yosemite toad, Northern Distinct Population Segment of the mountain yellow-legged frog, and/or Sierra Nevada yellow-legged frog.

(f) To avoid transferring disease or pathogens between suitable habitats during the course of translocating the three listed amphibians, Forest Service biologists or the Service-approved biologist shall use the following guidance for disinfecting equipment and clothing. These guidelines are adapted from the *Declining Amphibian Population Task Force's Code* which can be found in their entirety at: *http://www.open.ac.uk/daptf/*.

(g) At the project level, if adverse effects occur within suitable habitat, these areas will be restored to pre-existing conditions within one breeding season.

(h) Restoration will be implemented within the project area for areas at risk for erosion, such as those with soil compaction, lowered water tables, and downcutting and gullies (per S&G 122), if there is an adverse effect to suitable habitat for the three listed amphibians.

3. The following Term and Condition implements Reasonable and Prudent Measure Three (3). This Term and Condition further elucidates the monitoring program proposed by the Forest Service:

   a. The Forest Service shall complete scientific and statically robust monitoring of the effectiveness of Forest Service conservation measures in avoiding or minimizing effects of management actions identified by the Monitoring Team as important to the Sierra Nevada Yellow-legged Frog, Northern Distinct Population Segment of the Mountain Yellow-legged Frog, and the Yosemite Toad. The Study shall be reviewed and approved by the Service.

      i. The monitoring and analysis shall be designed and implemented to be statistically valid and robust in order to determine whether the Forest Service conservation measures for Sierra Nevada yellow-legged frog, Northern Distinct Population Segment of the mountain yellow-legged frog, Yosemite toad, and suitable habitat are being maintain and/or restore the species and their habitat for the identified management actions.

      ii. The samples shall be representative across geographic, elevational, management methods and intensities, and occupancy gradients of the three listed amphibians. The samples shall not be constrained by access, e.g. proximity to roads

      iii. The scale of inferences shall be clearly stated (e.g. bioregional, Forest, allotment, and meadow)

      iv. The sampling and reporting periods shall be clearly stated (e.g. every season, 3 years, 5 years, 10 years). Some factors, such as hydrological changes, meadow degradation or recovery, likely are slow, incremental and/or long-term. Therefore, given the biology of the three amphibians (e.g. Yosemite toad generation times are 4-5 years), collecting adequate data will require more than one or a few seasons.

v. The monitoring design and implementation schedule shall be developed by a team that includes demonstrated expertise in three listed amphibians, montane amphibian ecology, range ecology, montane meadow hydrology, and statistics (with monitoring design experience). The team shall be led by a herpetologist with demonstrated experience with the three listed amphibians. The team members shall be submitted to the Service for approval at least thirty (30) calendar days prior to formally informing the person that they are a member of the team. The goal is to develop and implement a monitoring program that will produce and analyze data, and results that are scientifically and statistically valid.

vi. The Forest Service shall ensure that the monitoring, analyses, and reporting, as designed by the team, and approved by the Service, are fully carried out.

vii. The final monitoring program that will be implemented by the Forest Service shall be provided to the Service for review and approval on or before 180 calendar days after the date of issuance of the programmatic biological opinion.

viii. The Forest Service shall submit a final report on the results and analyses of the monitoring report on the management activities of interest to the Sacramento Fish and Wildlife Office on or before March 1 for the monitoring conducted during the previous calendar year. A final report analyzing the previous data and studies shall be submitted to the Sacramento Fish and Wildlife Office on or before March 3 beginning three calendar years after the approval of the final monitoring program. The reports shall be addressed to the Chief of the Endangered Species Division (Forest/Foothill) Attention: Chris Nagano at the Sacramento Fish and Wildlife Office.

The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of programmatic incidental take that might otherwise result from the proposed action. If, during the course of a project appended to this programmatic biological opinion, the level of incidental take described for the specific listed amphibian is exceeded, such incidental take represents new information requiring review of the project, and, if appropriate, reinitiation of programmatic consultation and review of the reasonable and prudent measures provided. The Forest Service must provide an explanation of the causes of the take as soon as possible and review with the Service the need for possible review of the project, or modification of the reasonable and prudent measures.

Reporting Requirements

For projects appended to this programmatic biological opinion, injured Sierra Nevada yellow-legged frog, Northern Distinct Population Segment of the mountain yellow-legged frog, and the Yosemite toad shall be cared for by a licensed veterinarian or other qualified person such as a Forest Service biologist or a biologist possess a valid section 10(a)(1)(A) permit for the appropriate listed species; dead individuals must be placed in a sealed plastic bag with the date, time, location of discovery, and the name of the person who found the animal; the carcass shall be kept in a freezer; and held in a secure location. The Service must be notified within one (1) working day of the discovery of death or injury to a Sierra Nevada yellow-legged frog, Northern Distinct Population Segment of the mountain yellow-legged frog, and the Yosemite toad that occur due to project related activities or is observed or recovered at the project site. Notification will include the date, time, and location of the

incident or of the finding of a dead or injured animal clearly indicated on a U.S. Geological Survey 7.5 minute quadrangle and other maps at a finer scale, as requested by the Service, and any other pertinent information. The Service contact person is the Chief of the Endangered Species Division at the Sacramento Fish and Wildlife Office at (916) 414-6600.

The Forest Service shall submit an annual compliance report to the Sacramento Fish and Wildlife Office on or before March 1 for the projects appended to this programmatic biological opinion during the previous calendar year. This report shall include for each appended project (1) Project name, name of National Forest, Forest program, listed amphibian affected, dates implemented, location of each project, acreage of project, project activities which could have resulted in incidental take; (2) GIS layer of polygon of the appended projects; (3) other pertinent information. The reports shall be addressed to the Chief of the Endangered Species Division Attention: Chris Nagano at the Sacramento Fish and Wildlife Office.

Conservation Recommendations

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities that can be implemented to further the purposes of the Act, such as preservation of endangered species habitat, implementation of recovery actions, or development of information and databases. The Service has the following recommendations:

1. The Forest Service should continue their collaborative efforts to eliminate non-native trout from suitable habitat where they have been introduced within the ranges of the Sierra Nevada yellow-legged frog, Northern Distinct Population Segment of the mountain yellow-legged frog, and the Yosemite toad.

2. The Forest Service should assist the Service in implementing the Conservation Strategy, and when completed, the final recovery plan for the Sierra Nevada yellow-legged frog, Northern Distinct Population Segment of the mountain yellow-legged frog, and the Yosemite toad.

3. The Forest Service should avoid land trades/sales of parcels of land that contain suitable habitat of the three amphibian species.

4. The Forest Service should implement management strategies that specifically protect and manage the three amphibian species.

5. Where recreation conflicts with the three amphibian species and area closures are not practicable, the Forest Service should complete on-site scientifically based Service-approved monitoring, and education for users.

6. The Forest Service should provide interpretive signs and other information to educate visitors about the three amphibian species.

For the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, we request notification of the implementation of any of the conservation recommendations.

REINITIATION – CLOSING NOTICE

This concludes programmatic formal consultation on the effects of nine Forest programs on nine National Forests in the Sierra Nevada of California that adversely affect the Sierra Nevada yellow-legged frog, Northern Distinct Population Segment of the mountain yellow-legged frog, and the Yosemite toad. As provided in 50 CFR § 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been maintained (or is authorized by law) and if: (1) the amount or extent of incidental take for a project(s) appended to this programmatic biological opinion is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this programmatic biological opinion; (3) the agency action (appended project) is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this programmatic biological opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take, including projects appended to this programmatic biological opinion, must cease pending reinitiation.

If you have questions about this programmatic biological opinion, please contact Chris Nagano, or Cay Goude in our Endangered Species Program at the letterhead address, or email (Chris_Nagano@fws.gov; Cay_Goude@fws.gov) or at telephone (916) 414-6600.

Sincerely,

Jennifer M. Norris
Field Supervisor

Enclosure

cc:
Diana Craig, U.S. Forest Service, Vallejo, California
Diane McFarlane, U.S. Forest Service, Vallejo, California
Laura Patterson, California Department of Fish and Wildlife, Sacramento, California
Sarah Boogay, California Department of Fish and Wildlife, Fresno, California
Regional Manager, California Department of Fish and Wildlife, Redding, California
Regional Manager, California Department of Fish and Wildlife, Rancho Cordova, California
Regional Manager, California Department of Fish and Wildlife, Fresno, California

Literature Cited

Adams, M.J., C.A. Pearl, B. McCreary, S.K. Galvan. 2009. Short-term effect of cattle exclosures on Columbia spotted frog (*Rana luteiventris*) populations and habitat in northeastern Oregon. Journal of Herpetology 43:132–138.

Adger, N., P. Aggarwal, S. Agrawala, J. Alcamo, A. Allali, O. Anisimov, N. Arnell, M. Boko, . Canziani, T. Carter, G. Cassa, U. Confalonieri, R. Cruz, E. de Alba Alcaraz, W. Eastreling, . Field, A. Fischlin, B. Fitzharris, C.G. Garcia, C. Hanson, H. Harasawa, K. Hennessy, S. Huq, R. Jones, L. K. Bogataj, D. Karoly, R. Kliein, Z. Kundzewicz, M. Lal, R. Lasco, G. Love, X. Lu, G. Magrin, L.J. Mata, R. McLean, B. Menne, G. Midgley, N. Mimura, M.Q. Mirza, J. Moreno, L. Mortsch, I. Niang-Diop, R. Nichols, B. Novaky, L. Nurse, A. Nyon, M. Oppenheimer, J. Palutikof, M. Parry, A. Patwardhan, P. R. Lankao, C. Rosenzweig, S. Schneider, S. Semenov, J. Smith, J. Stone, J. van Ypersele, D. Vaughan, C. Vogel, T. Wilbanks, P. Wong, S. Wu, and G. Yohe. 2007. Working Group II Contribution to the Intergovernmental Panel on Climate Change Fourth Assessment Report. Climate Change 2007: Climate change impacts, adaptation and vulnerability. Brussels, Belgium.

Allen, M.R., J.F.B. Mitchell, and P.A. Scott. 2013. Test of a decadal climate forecast. Nature Geoscience 6:243-244.

Allen-Diaz, B., S.K. McIlroy, L.M. Roche, K.W. Tate, and A.J. Lind. 2010. Determining the effects of livestock grazing on Yosemite toads (*Bufo canorus*) and their habitat: final report to Forest Service Region 5. U.S. Forest Service, Vallejo, California.

Andrews, K.M., J.W. Gibbons, and D.M. Jochimsen. 2008. Ecological effects of roads on amphibians and reptiles: A literature review. Pages 121-143 *in* Mitchell, J.C., Brown, R.E.J., B. Bartholomew (editors). Urban Herpetology. Society for the Study of Amphibians and Reptiles.

Armour, C.A., D.A. Duff, and W. Elmore. 1994. The effects of livestock grazing on western riparian and stream ecosystems. Fisheries 19:9-12.

Bahls, P. 1992. The status of fish populations and management of high mountain lakes in the western United States. Northwest Science 66:183-193.

Bartelt, P.E. 1998. *Bufo boreas* (Western Toad) Mortality. Herpetological Review 29:96.

Beebee, T.J.C. 2013. Effects of Road Mortality and Mitigation Measures on Amphibian Populations. Conservation Biology 27:657–668.

Belsky, A.J., A. Matzke, and S. Uselman. 1999. Survey of livestock influences on stream and riparian ecosystems in the western United States. Journal of Soil and Water Conservation. 54:419–431.

Berger, L., R. Speare, Daszak, D.E. Green, A.A., Cunningham, C.L. Goggin, R. Slocombe, M.A. Ragan, A.D. Hyatt, K.R. McDonald, H.B. Hines, L.R. Lips, G. Marantelli, and H. Parkes. 1998. Chytridiomycosis causes amphibian mortality associated with population declines in the rain forests of Australia and Central America. Proceedings of the National Academy of Sciences 95:9031-9036.

Biek, R., C. Funk, B.A. Maxell, and L.S. Mills. 2002. What is missing in amphibian decline research: insights from ecological sensitivity analysis. Conservation Biology 16:728–734.

Blair, W.F. 1964. Evidence bearing on the relationships of the *Bufo boreas* group of toads. Texas Journal of Science 16:181–192.

_____. 1972. Evolution in the genus *Bufo*. University of Texas Press, Austin, Texas.

Blaustein, A.R., Walls, S.C., Bancroft, B.A., Lawler, J.J., Searle, C.L. and S.S. Gervasi. 2010. Direct and indirect effects of climate change on amphibian populations. Diversity 2:281-313.

Boyle, S.A., and F.B. Samson. 1985. Effects of non-consumptive recreation on wildlife. A review. Wildlife Society Bulletin 13:110-116.

Bradford, D.F. 1983. Winterkill, oxygen relations, and energy metabolism of a submerged dormant amphibian, *Rana muscosa*. Ecology 64:1171-1183.

_____. 1984. Temperature modulation in a high elevation amphibian, *Rana muscosa*. Copeia 1984(4):966–976.

_____. 1989. Allotopic distribution of native frogs and introduced fishes in high Sierra Nevada lakes of California: implication of the negative effect of fish introductions. Copeia 1989:775-778.

_____. 1991. Mass mortality and extinction in a high-elevation population of *Rana muscosa*. Journal of Herpetology 25:174-177.

Bradford, D.F., D.M. Graber, and F. Tabatabai. 1994. Population declines of the native frog, *Rana muscosa*, in Sequoia and Kings Canyon National Parks, California. Southwestern Naturalist 39:323-327.

Bradford, D.F., S.D. Cooper, T.M. Jenkins, K. Kratz, O. Sarnelle, and A.D. Brown. 1998. Influences of natural acidity and introduced fish on faunal assemblages in California alpine lakes. Canadian Journal of Fisheries and Aquatic Sciences 55(11):2478-2491.

Bradford, D.F., R.A. Knapp, D.W. Sparling, M.S. Nash, K.A. Stanley, N.G. Tallent-Halsell, L.L. McConnell, and S.M. Simonich. 2011. Pesticide distributions and population declines of California, USA alpine frogs, *Rana muscosa* and *Rana sierrae*. Environmental Toxicology and Chemistry 30:682-691.

Bradford, D.F., F. Tabatabai, and D.M. Graber. 1993. Isolation of remaining populations of the native frog, *Rana muscosa*, by introduced fishes in Sequoia and Kings Canyon National Parks, California. Conservation Biology 7:882-888.

Briggs, C.J., Knapp, R.A., and V.T. Vredenburg. 2010. Enzootic and epizootic dynamics of the chytrid fungal pathogen of amphibians. Proceedings of the National Academy of Science 107:9695–9700.

Brown, C., Hayes, M., Green, G., and D. Macfarlane. 2009. Yosemite Toad Conservation Assessment. DRAFT. 30 September, 2009.

_____. 2014. Mountain Yellow-legged Frog Conservation Assessment for the Sierra Nevada. DRAFT. 14 January 2014.

Brown, C., K. Kiehl, and L. Wilkinson. 2012. Advantages of long-term, multi-scale monitoring: assessing the current status of the Yosemite toad (*Anaxyrus* [*Bufo*] *canorus*) in the Sierra Nevada, California, USA. Herpetological Conservation and Biology 7(2):115–131.

Brown, C., L. Wilkinson, and K. Kiehl. 2011. Status and trend of the mountain yellow-legged Frog, Yosemite toad and Pacific chorus frog in the Sierra Nevada, CA: Results from the First Monitoring Cycle of the USDA Forest Service Sierra Nevada Amphibian Monitoring Program DRAFT. Pinole, California.

Brown, C., Wilkinson, L., and K. Kiehl. 2014. Comparing the Status of two Sympatric Amphibians in the Sierra Nevada, California: Insights on Ecological Risk and Monitoring Common Species. Journal of Herpetology 48:74-83. 2014.

Bull, E.L., and M.P. Hayes. 2000. Effects of livestock on reproduction of the Columbia spotted frog. Journal of Range Management 53:291–294.

Burton, E.C., Gray, M.J., Schmutzer, A.C. and D.L. Miller. 2009. Differential responses of postmetamorphic amphibians to cattle grazing in wetlands. Journal of Wildlife Management 73:269–277.

Bury, R.B. 2004. Wildfire, fuel reduction, and herpetofaunas across diverse landscape mosaics in Northwestern forests. Conservation Biology 18:968-975.

California Climate Action Team. 2006. Climate Action Team Report to Governor Schwarzenegger and the Legislature. California Environmental Protection Agency, Sacramento, California.

California Department of Fish and Game (CDFG). 1994. Adoption of regulations for suction dredge mining. Amended Draft Environmental Impact Report. Rancho Cordova, California.

California Department of Fish and Wildlife. 2011. A status review of the mountain yellow-legged frog (*Rana sierrae* and *Rana muscosa*). Report to the Fish and Game Commission. California Department of Fish and Wildlife, Sacramento, California.

_____. 2014a. California Natural Diversity Data Base (CNDDB) RAREFIND. Natural Heritage Division, Sacramento, California.

_____. 2014b. BIOSIS. Natural Heritage Division, Sacramento, California.

California State Lands Commission. 1993. California's rivers: A public trust report. Sacramento, California.

Camp, C.L. 1916. Description of *Bufo canorus*, a new toad from Yosemite National Park. University of California Publications in Zoology 17:59–62.

Chapman, D.W. 1988. Critical review of variables used to define effects of fines in redds of large salmonids. Transactions of the American Fisheries Society 117:1-21.

Chaney, E., W. Elmore, and W.S. Platts. 1990. Livestock grazing on western riparian areas. U.S. Environmental Protection Agency and the Northwest Resource Information Center. Eagle, Idaho.

_____. 1917. Notes on the systematic status of the toads and frogs of California. University of California Publications in Zoology 17:115-125.

Cole, D.N. 1986. Recreational impacts on backcountry campsites in Grand Canyon National Park, Arizona, USA. Environmental Management 10:651-659.

Cole, D.N., and J.L. Marion. 1988. Recreation impacts in some riparian forests of the Eastern United States. Environmental Management 12:99-107.

Cole, D.N., and R.K. Fichtler. 1983. Campsite impact on three western wilderness areas. Environmental Management 7:275-288.

Cole, D.N., J.W. Van Wagtendonk, M.P. McClaran, P.E. Moore, and N. McDougald. 2004. Response of mountain meadows to grazing by recreational pack stock. Journal of Range Management 57:153-160.

Davidson, C. and Fellers, G.M. 2005. *Bufo canorus* Camp 1916, Yosemite Toad. Pages 400-401 *in*: Lannoo, M. (editor). Amphibian Declines: The Conservation Status of United States Species. University of California Press, Berkeley, California.

Davidson, C., H.B. Shaffer, and M.R. Jennings. 2002. Spatial tests of the pesticide drift, habitat destruction, UV-B, and climate-change hypotheses for California amphibian declines. Conservation Biology 16:1588-1601

Derlet, R.W. and J.R. Carlson. 2006. Coliform bacteria in Sierra Nevada wilderness lakes and streams: what is the impact of backpackers, pack animals, and cattle? Wilderness and Environmental Medicine 17:15-20.

Derlet, R.W., K.A. Ger, J.R. Richards, and J.R. Carlson. 2008. Risk factors for coliform bacteria in backcountry lakes and streams in the Sierra Nevada mountains: a 5-year study. Wilderness and Environmental Medicine 19:82-90.

Derlet, R.W., S.R. Goldman, and M.J. Connor. 2010. Reducing the impact of summer cattle grazing on water quality in the Sierra Nevada mountains of California: a proposal. Journal of Water and Health 2010.

Dodd, C.K. 2013a. Frogs of the United States and Canada. Volume 1. John Hopkins University Press. Baltimore, Maryland.

_____. 2013b. Frogs of the United States and Canada. Volume 2. John Hopkins University Press. Baltimore, Maryland.

Drost, C.A. and G. Fellers. 1996. Collapse of a regional frog fauna in the Yosemite area of the California Sierra Nevada, USA. Conservation Biology 10:414-425.

Feder, J.H. 1977. Genetic variation and biochemical systematics in western *Bufo*. Masters thesis, University of California, Berkeley, California.

Feldman, C.R., and J.A. Wilkinson. 2000. *Rana muscosa* (mountain yellow-legged frog). Predation. Herpetological Review 31:102.

Fellers, G. M., D. F. Bradford, D. Platt, and L.L. Wood. 2007. Demise of repatriated populations of mountain yellow-legged frogs (*Rana muscosa*) in the Sierra Nevada of California. Herpetological Conservation and Biology 2:5-21.

Finlay, J.C., and V.T. Vredenburg. 2007. Introduced trout sever trophic connections in watersheds: consequences for a declining amphibian. Ecology 88(9):2187–2198.

Ford, L.D., P.A. Van Hoorn, D.R. Rao, N.J. Scott, P.C. Trenham, and J.W. Bartolome. 2013. Managing Rangelands to Benefit California Red-legged Frogs and California Tiger Salamanders. Alameda County Resource Conservation District, Livermore, California.

Garton, E.O., T.C. Foin, C. W. Bowen, J.M. Everingham, R. O. Schultz, and B. Holton, Jr. 1977. Quantitative studies of visitor impacts on environments of Yosemite National Park, California, USA and their implications for park management policy. Journal of Environmental Management 5:1-22.

Grasso, R.L.. R.M. Coleman, C. Davidson. 2010. Palatability and antipredator response of Yosemite toads (*Anaxyrus canorus*) to nonnative brook trout (*Salvelinus fontinalis*) in the Sierra Nevada mountains of California. Copeia 2010:457–462.

Green, D.E., and C. Kagarise Sherman. 2001. Diagnostic histological findings in Yosemite Toads (*Bufo canorus*) from a die-off in the 1970s. Journal of Herpetology 35:92-103.

Green, D.M., L.A. Weir, G.S. Casey, and M.J. Lannoo. 2014. North American amphibians distribution and diversity. University of California, Berkeley, California.

Grinnell, J. and T.I. Storer. 1924. Animal life in Yosemite: an account of the mammals, birds, reptiles, and amphibians in a cross-section of the Sierra Nevada. University of California Press. Berkeley, California.

Harvey, B.C., and T.E. Lisle. 1998. Effects of suction gold dredging on streams: A review and evaluation strategy. Fisheries 23:8-17.

Haugen G., D. Duff. 1982. The Best Management Practices for the Management and Protection of Western Riparian Ecosystems. Riparian habitat committee, Western Division American Fisheries Society.

Heller, C.L. 1960. The Sierra yellow-legged frog. Yosemite Nature Notes 39(5):126–128.

Hossack, B. R., and D. S. Pilliod. 2011. Amphibian responses to wildfire in the western United States- Emerging patterns from short-term studies. Fire Ecology 7(2):129-144.

Hossack, B.R., W.H. Lowe, and P.S. Corn. 2012. Rapid increases and time-lagged declines in amphibian occupancy after wildfire. Conservation Biology 27:219–228.

Hossack, B.R., L.A. Eby, C.G. Guscio, and P.S. Corn. 2009. Thermal characteristics of amphibian microhabitats in a fire-disturbed landscape. Forest Ecology and Management 258: 1414–1421.

Hurteau, M.D., A.L. Westerling, C. Wiedinmyer, and B. P. Bryant. 2014. Projected effects of climate and development on California wildfire emissions through 2100. Environmental Science and Technology 48(4):2298-2304.

Jennings, M.R. and M.P. Hayes. 1994. Amphibian and reptile species of special concern in California. California Department of Fish and Game. Rancho Cordova, California

Jansen, A., and M. Healey. 2003. Frog communities and wetland condition: relationships with grazing by domestic livestock along an Australian floodplain river. Biological Conservation 109:207–219.

Jenkins, T.M. 1994. Aquatic biota in the Sierra Nevada: current status and potential effects of acid deposition on populations. Final Report Contract A932-138. California Air Resources Board, Sacramento.

Kadir, T., L. Mazur, C. Milanes, and K. Randles. 2013. Indicators of Climate Change in California. California Environmental Protection Agency, Office of Environmental Health Hazard Assessment, Sacramento, California.

Kagarise, Sherman, C. 1980. A comparison of the natural history and mating system of two anurans: Yosemite toads (*Bufo canorus*) and black toads (*Bufo exsul*). PhD dissertation, University of Michigan, Ann Arbor, Michigan.

Kagarise, Sherman, C.K.; Morton, M.L. 1984. The toad that stays on its toes. Natural History. 93: 72-78.

Kagarise, Sherman, C. and M.L. Morton. 1993. Population declines of Yosemite toads in the eastern Sierra Nevada of California. Journal of Herpetology 27:186–198.

Karlstrom, E.L. 1962. The toad genus *Bufo* in the Sierra Nevada of California: ecological and systematic relationships. University of California Publications in Zoology 62:1–104.

Karlstrom, E.L., and R.L. Livezey. 1955. The eggs and larvae of the Yosemite toad *Bufo canorus* Camp. Herpetologica 11:221-227.

Kattelmann, R. 1996. Hydrology and water resources. Volume II chapter 30 *in*: Sierra Nevada Ecosystem Project: Final report to Congress. Centers for Water and Wildland Resources, University of California, Davis, California.

Kattelmann, R., and M. Embury. 1996. Riparian Areas and Wetlands. In: Sierra Nevada ecosystem project, final report to Congress. University of California, Davis, Calfornia.

Kauffman, J.B., and W.C. Krueger. 1984. Livestock impacts on riparian ecosystems and streamside management implications a review. Journal of Range Management 37(5):430–437.

Kauffman, J.B., W.C. Krueger, and M. Vavra. 1983. Impacts of cattle on streambanks in Northeastern Oregon. Journal of Range Management 683–685.

Knapp R.A. 2005a. Results of amphibian resurveys in Sequoia-Kings Canyon National Park. Unpublished Interim Report. Sierra Nevada Aquatic Research Laboratory, Mammoth Lakes, California.

_____. 2005b. Effects of nonnative fish and habitat characteristics on lentic herpetofauna in Yosemite National Park, USA. Biological Conservation 121:265-279

Knapp, R.A., D.M. Boiano, and V.T. Vredenburg. 2007. Removal of nonnative fish results in population expansion of a declining amphibian (mountain yellow-legged frog, *Rana muscosa*). Biological Conservation 135:11-20

Knapp, R.A., and K.R. Matthews. 2000a. Non-native fish introductions and the decline of the mountain yellow-legged frog from within protected areas. Conservation Biology 14:428-438.

_____. 2000b. Effects of non-ative fishes on wilderness lake ecosystems in the Sierra Nevada and recommendations for reducing impacts. USDA Forest Service Proceedings RMRS-P-15-Vol-5.

Knapp, R.A., K.R. Matthews, and O. Sarnelle. 2001. Resistance and resilience of alpine lake fauna to fish introductions. Ecological Monographs 71:401–421.

Knapp, R.A., K.R. Matthews, H.K. Preisler, and R. Jellison. 2003. Developing probabilistic models to predict amphibian site occupancy in a patchy landscape. Ecological Applications 13:1069–1082.

Knight, R.L., and D.N. Cole. 1991. Effects of recreational activity on wildlife in wildlands. Transactions of the 56th North American Wildlife and Natural Resources Conference 56:238-247.

Knutsen, M.G., W.B. Richardson, and D.M. Reineke. 2004. Agricultural Ponds Support Amphibian Populations. Ecological Applications 14:669–684.

Lacan, I., K. Matthews, and K. Feldman. 2008. Interaction of an introduced predator with future effects of climate change in the recruitment dynamics of the imperiled Sierra Nevada yellow-legged frog (*Rana sierrae*). Herpetological Conservation and Biology 3:211–223.

Lannoo, M.J. (Editor). 2005. Amphibian declines the status and conservation of United States species. University of California Press, Berkeley, California.

Larson, D.J. 1996. Historical water-use priorities and public policies. Pages 163-185 *in* Sierra Nevada Ecosystem Project: Final report to Congress Volume II. Centers for Water and Wildland Resources Report. University of California, Davis, California.

Lefcort, H., K.A. Hancock, K.M. Maur, and D.C. Rostal. 1997. The effects of used motor oil, silt and the water mold *Saprolegnia parasitica* on the growth and survival of mole salamanders (genus *Ambystoma*). Archives of Environmental Contamination and Toxicology 32:383-388.

Liang, C.T. 2010. Habitat modeling and movements of the Yosemite toad (*Anaxyrus* (= *Bufo*) *canorus*) in the Sierra Nevada, California. PhD dissertation. University of California, Davis California.

Liang, C.T., S.L. Barnes, H. Eddinger, and A.J. Lind. 2010. Species distribution model of the Yosemite toad in the Sierra National Forest, California. USDA Forest Service, Pacific Southwest Research Station, Sierra Nevada Research Center, Davis, California. Report to U.S. Fish and Wildlife Service. Sacramento, California.

Liang, C.T., and T.J. Stohlgren. 2011. Habitat suitability of patch types: A case study of the Yosemite toad. Frontiers in Earth Sciences 5: 217-228.

Lind, A., R. Grasso, J. Nelson, K. Vincent, C. Liang, K. Tate, L. Roche, B. Allen-Diaz, and S. Mcilroy. 2011. Determining the Effects of Livestock Grazing on Yosemite Toads (*Anaxyrus* [*Bufo*] *canorus*) and Their Habitat: An Adaptive Management Study. Pacific Southwest Research Station, Sierra Nevada Research Center, Davis, California.

Livezey, R.L., and A.H. Wright. 1945. Descriptions of four salientian eggs. American Midland Naturalist 34:701–706.

Longcore, J. E., A.P. Pessier, and D.K. Nichols. 1999. *Batrachochytrium dendrobatidis* gen. et sp. nov., a chytrid pathogenic to amphibians. Mycologia 91:219–227.

Macey, J.R., J. Strasburg, J. Brisson, V.T. Vrendenburg, M. Jennings, and A. Larson. 2001. Molecular phylogenetics of western North American frogs of the *Rana boylii* species group. Molecular Phylogenetics and Evolution 18:131-143.

Mahaney, P.A. 1994. The effects of freshwater petroleum contamination on amphibian hatching and metamorphosis. Environmental Toxicology 13:259-265.

Mao, J., D.E. Green, G. Fellers, and V.G. Chinchat. 1999. Molecular characterization of iridioviruses isolated from sympatric amphibians and fish. Virus Research 63:45-52.

Marlow, C.B. and T.M. Pogacnik. 1985. Time of grazing and cattle-induced damage to streambanks. Paper presented at the North American Riparian Conference. University of Arizona, Tucson, Arizona.

Martin, D.L. 1992. Sierra Nevada anuran survey: an investigation of amphibian population abundance in the national forests of the Sierra Nevada of California. Report to U.S. Forest Service. Canorus Ltd., Sacramento, California.

_____. 2008. Decline, movement, and habitat utilization of the Yosemite toad (*Bufo canorus*): An endangered anuran endemic to the Sierra Nevada of California. PhD dissertation. University of California, Santa Barbara, California.

Matthews, K.R., and H.K. Preisler. 2010. Site fidelity of the declining amphibian *Rana sierrae* (Sierra Nevada yellow-legged frog). Canadian Journal of Fisheries and Aquatic Science 67:243-255.

Mazerolle, M.J., M. Huot, and M. Gravel. 2005. Behavior of amphibians on the road in response to car traffic. Herpetologica 61:380-388.

McIlroy, Susan K., A. Lind, B. Allen-Diaz, L. Roche, W. Frost, R. Grasso, and K. Tate. 2013. Determining the effects of cattle grazing treatments on Yosemite toads (*Anaxyrus* [=Bufo] *canorus*) in montane meadows. PLoS ONE 8(11):79263.

McMenamin, S.K., E.A. Hadlya, and C.K. Wright. 2008. Climatic change and wetland desiccation cause amphibian decline in Yellowstone National Park. Proceedings of the National Academy of Sciences 105:16988–16993.

Meehan, W.R. and W.S. Platts. 1978. Livestock grazing and the aquatic environment. Journal of Soil and Water Conservation 6:274–278.

Melillo, J.M., T. Richmond, and G.W. Yohe. 2014. Climate change impacts in the United States: The Third National Climate Assessment. U.S. Global Change Research Program, Washington, D.C.

Menke, J.W, C. Davis, and P. Beesley. 1996. Rangeland assessment. In: Sierra Nevada ecosystem project, final report.

Monastersky, R. 2013. Global carbon dioxide levels near worrisome milestone. Nature 497:14.

Moore, P.E., D.N. Cole, J.W. Wagtendonk, M.P. McClaran, and N. McDougald. 2000. Meadow response to pack stock grazing in the Yosemite wilderness: integrating research and management. In: Wilderness ecosystem, threats, and management, Volume 5. RMRS-P-15-VOL-5; Proceedings of the Wilderness science in a time of change conference, 23-27 May 1999. Missoula, Montana. USDA Forest Service, Rocky Mountain Research Station: 160–164.

Morton, M.L., and M.E. Pereyra. 2010. Habitat use by Yosemite toads: life history traits and implications for conservation. Herpetological Conservation and Biology 5:388-394.

Morton, M.L., and K.N. Sokolski. 1978. Sympatry in *Bufo boreas* and *Bufo canorus* and evidence of natural hybridization. Bulletin of the Southern California Academy of Science 77:52–55.

Moyle, P.B., R.M. Yoshiyama, and R.A. Knapp. 1996. Status of fish and fisheries. Pages 953-973 *in* Sierra Nevada Ecosystem Project: final report to Congress. Volume II. Centers for Water and Wildland Resources, University of California, Davis, California.

Mullally, D.P. 1953. Observations on the ecology of the toad *Bufo canorus*. Copeia 1953:182-183.

_____. 1956. The relationships of the Yosemite and western toads. Herpetologica 12:133–135.

Mullally, D.P., and J.D. Cunningham. 1956. Ecological relations of *Rana muscosa* at high elevations in the Sierra Nevada. Herpetologica 12:189–198.

Nelson, R.L., M.L. McHenry, and W.S. Platts. 1991. Mining Pages 425-457 *in* W.R. Meehan (Editor). Influences of Forest and Rangeland Management on Salmonid Fishes and their Habitats. American Fisheries Society Special Publication 19:425-457.

Newcombe, C.P., and D.D. MacDonald. 1991. Effects of suspended sediments on aquatic ecosystems. North American Journal of Fisheries Management 11:72-84.

Obedzinski, R.A., C.G. Shaw III, and D.G. Neary. 2001. Declining woody vegetation in riparian ecosystems of the western United States. Western Journal of Applied Forestry 16:169–180.

Olson, D.H. 1989. Predation on breeding western toads (*Bufo boreas*). Copeia 1989:391–397.

Olson-Rutz, K.M., C.B. Marlow, K. Hansen, L.C. Gagnon, and R.J. Rossi. 1996a. Packhorse grazing behavior and immediate impact on a timberline meadow. Journal of Range Management 49(6):546-550.

_____. 1996b. Recovery of a high elevation plant community after packhorse grazing. Journal of Range Management 49(6):541-545.

Ott, A.G. 1985. Fish Protection and Placer Mining. Alaska Fish and Game March-April 1985.

Point Reyes Bird Observatory. 2011. Projected effects of climate change in California: Ecoregional summaries emphasizing consequences for wildlife. Point Reyes Bird Observatory Conservation Science, Petaluma, California.

Pope, K. 1999. *Rana muscosa* (mountain yellow-legged frog): Diet. Herpetological Review 30(3): 163–164.

Pope, K.L., and K.R. Matthews. 2001. Movement ecology and seasonal distribution of mountain yellow-legged frogs, *Rana muscosa*, in a high-elevation Sierra Nevada basin. Copeia 2001:7 87-793.

Power, M. E. 1990. The importance of sediment in the grazing ecology and size class interactions of an armored catfish, *Aneistrus spinosus*. Environmental Biology of Fish 10:173-181.

Rachowicz, L.J., R.A. Knapp, and J.A.T. Morgan. 2006. Emerging infectious disease as a proximate cause of amphibian mass mortality. Ecology 87:1671–1683.

Ratliff, R.D. 1985. Meadows on the Sierra Nevada of California: state of knowledge. General Technical Report. PSW-84, Pacific Southwest Forest and Range Experiment Station. U.S. Forest Service, Pinole, California.

Roche, L.M., B. Allen-Diaz, D.J. Eastburn, and K.W. Tate. 2012a. Cattle grazing and Yosemite toad (*Bufo canorus* Camp) breeding habitat in Sierra Nevada meadows. Rangeland Ecology and Management 65:56–65.

Roche, L.M., A.M. Latimer, D.J. Eastburn, and K.W. Tate. 2012b. Cattle grazing and conservation of a meadow-dependent amphibian species in the Sierra Nevada. PLoS ONE 7:35734.

Rodríguez-Prieto, I., and E. Fernández-Juricic. 2005. Effects of direct human disturbance on the endemic Iberian frog *Rana iberica* at individual and population levels. Biological Conservation 123:1–9.

Sadinski, W.J. 2004. Amphibian declines: Causes. Final report to The Yosemite Fund.

Schiermeier, Q. 2012. Hot Air Commitments made under the Kyoto Climate Treaty expire at the end of 2012, but emissions are rising faster than ever. Nature 491:656-658.

Schlumpf, M., B. Cotton, M. Conscience, V. Haller, B. Steinmann, and W. Lichtensteiger. 2001. In vitro and in vivo estrogenicity of UV screens. Environmental Health Perspectives 109:239-244.

Shaffer M.L. 1981. Minimum population sizes for species conservation. Bioscience 31:131–134.

Shaffer, H.B., G.M. Fellers, A. Magee, and R. Voss. 2000. The genetics of amphibian declines: population substructure and molecular differentiation in the Yosemite toad, *Bufo canorus*, (Anura, Bufonidae) based on single strand conformation polymorphism analysis (SSCP) and mitochondrial DNA sequence data. Molecular Ecology 9:245–257.

Skerratt, L.F., L. Berger, R. Speare, S. Cashins, K.R. McDonald, A.D. Phillott, H.B. Hines, and N.Kenyon. 2007. Spread of chytridiomycosis has caused the rapid global decline and extinction of frogs. EcoHealth 4:125–134.

Stebbins, R.C. 1951. Amphibians of western North America. University of California Press. Berkeley, California.

_____. 2003. A field guide to western reptiles and amphibians. Houghton Mifflin. Boston, Massachusetts.

Stebbins, R.C. and N.W. Cohen. 1995. A natural history of amphibians. Princeton University Press, Princeton, New Jersey.

Stebbins, R.C. and S.M. McGinnis. 2012. Field guide to amphibians and reptiles of California. University of California Press. Berkeley, California.

Stephens, M.R. 2001. Phylogeography of the *Bufo boreas* (Anura, Bufonidae) species complex and the biogeography of California. Masters thesis, Sonoma State University. Santa Rosa, California.

Stice, M.J., and C.J. Briggs. 2010. Immunization is ineffective at preventing infection and mortality due to the amphibian chytrid fungus *Batrachochytrium dendrobatidis*. Journal of Wildlife Diseases 46:70-77.

Stohlgren, T.J., and D.J. Parsons. 1986. Vegetation and soil recovery in wilderness campsites closed to visitor use. Environmental Management 10:375-380.

Storer, T.I. 1925. A synopsis of the Amphibia of California. University of California Publications in Zoology 27.

Stuart, J.M., M.L. Watson, T.L. Brown, and C. Eustice. 2001. Plastic netting: an entanglement hazard to snakes and other wildlife. Herpetological Review 32(3):162-164.

Tollefson, J. ,and R. Monastersky. 2012. Awash in carbon more than ever, nations are powering themselves from abundant supplies of fossil fuels. Nature 491:654-655.

U.S. Fish and Wildlife Service. 2014. Endangered and threatened wildlife and plants; Endangered status for the Sierra Nevada yellow-legged frog and the northern district population segment of the mountain yellow-legged frog, and threatened status for the Yosemite toad. **Federal Register** 79:24256-245310.

U.S. Forest Service (USFS). 2001a. Fisheries Programmatic Biological Evaluation for Selected Mining Related Activities and Westslope Cutthroat Trout. Helena, Lincoln, and Townsend Ranger Districts.

_____. 2001b. Sierra Nevada Forest Plan Amendment, Final Environmental Impact Statement.

_____. 2004. Sierra Nevada Forest Plan Amendment, Final Supplemental Environmental Impact Statement, Volume 1. U.S. Forest Service.

_____. 2012. Aquatic Species Biological Assessment and Biological Evaluation for the Kaiser Range Grazing Allotment. High Sierra Ranger District, Sierra National Forest, Fresno County, California.

_____. 2013a. Aquatic Species Biological Assessment and Biological Evaluation for the Bald Mountain Project (Ecological Restoration and Fuels Reduction). High Sierra Ranger District, Sierra National Forest, Fresno County, California.

_____. 2013b. Lake Tahoe Basin Management Unit Biological Assessment: Land and Resource Management Plan Revision Final Environmental Impact Statement.

_____. 2014. BEH Rangeland Allotments, Draft Environmental Impact Statement, R5-MB-245. Stanislaus National Forest, Sonora, California.

_____. 2014. Natural Resource Information System. Vallejo, California.

U. S. Forest Service (USFS), California Department of Fish and Game, National Park Service, U.S. Fish and Wildlife Service, and U.S. Geological Survey. 2009. Yosemite Toad Conservation Assessment Draft. Pinole, California.

U.S. Global Change Research Program. 2013. Federal Advisory Committee draft climate assessment report. Washington, D.C.

Vale, T.R. 1987. Vegetation change and park purposes in the high elevations of Yosemite National Park, California. Annals of the Association of American Geographers 77(1):1-18.

Vankat, J.L., and J. Major. 1978. Vegetation changes in Sequoia National Park, California. Journal of Biogeography 5:377-402.

Voyles J., L. Berger, S. Young, R. Speare, and R. Webb. 2007. Electrolyte depletion and osmotic imbalance in amphibians with chytridiomycosis. Diseases of Aquatic Organisms 77:113-118.

Voyles, J., S. Young, L. Berger, C. Campbell, and W.F. Voyles. 2009. Pathogenesis of chytridiomycosis, a cause of catastrophic amphibian declines. Science 326:582-585.

Vredenburg, V. T. 2000. Natural history notes: *Rana muscosa* (mountain yellow-legged frog), conspecific egg predation. Herpetological Review 31:170-171.

_____. 2004. Reversing introduced species effects: experimental removal of introduced fish leads to rapid recovery of a declining frog. Proceedings of the National Academy of Sciences 101:7646–7650.

Vredenburg, V.T., R. Bingham, R. Knapp, J.A.T. Morgan, C. Moritz, and D. Wake. 2007. Concordant molecular and phenotypic data delineate new taxonomy and conservation priorities for the endangered mountain yellow-legged frog. Journal of Zoology 271:361–374.

Vredenburg, V.T., G. Fellers, and C. Davidson. 2005. The mountain yellow-legged frog *Rana muscosa* (Camp 1917). Pages 563-566 *in* Lannoo, M. (editor). Status and conservation of US amphibians. University of California Press, Berkeley, California.

Vredenburg, V.T., R. Knapp, T.S. Tunstall, and C. Briggs. 2010. Dynamics of an emerging disease drive large-scale amphibian population extinctions.

Vredenburg, V., T. Tunstall, R. Bingham, J. Yeh, S. Schoville, C. Briggs, and C. Moritz. 2004. Patterns of habitat use and movement of *Rana muscosa* in the northern Sierra Nevada with comparisons to populations in the southern Sierra Nevada, with additional information on the biogeography of the species. Final Report for California Department of Fish and Game, Habitat Conservation Planning Group and the USDA Forest Service.

Wagoner, L. 1886. Report on forests of the counties of Amador, Calaveras, Tuolumne, and Mariposa. First biennial report of the California State Board of Forestry for the years 1885-1886. State Board of Forestry, Sacramento, California.

Walls, S.C., W.J. Barichivich, and M.E. Brown. 2013. Drought, Deluge and Declines: The Impact of Precipitation Extremes on Amphibians in a Changing Climate. Biology 2:399-418.

Wang, I.J. 2012. Environmental and topographic variables shape genetic structure and effective population sizes in the endangered Yosemite toad. Diversity and Distributions 18:1033–1041.

Weixelman, D. A., B. Hill, D.J. Cooper, E.L. Berlow, J.H. Viers, S.E. Purdy, A.G. Merrill, and S.E. Gross. 2011. A Field Key to Meadow Hydrogeomorphic Types for the Sierra Nevada and Southern Cascade Ranges in California. General Technical Report R5-TP-034.

Wengert, G. 2008. Habitat Use, home range, and movements of mountain yellow-legged frogs (*Rana muscosa*) in Bean and Spanish Creeks on the Plumas National Forest. Final Report to the Sacramento Fish and Wildlife Office, U.S. Fish and Wildlife Service. Sacramento, California.

Wright, A.H., and A.A. Wright. 1949. Handbook of frogs and toads. Comstock Publishing, Ithaca, New York.

Wright, A.N., R.J. Hijmans, M.W. Schwartz, and H.B. Shaffer. 2013. California amphibian and reptile species of future concern: conservation and climate change. Final report to the California Department of Fish and Wildlife, Sacramento, California.

Zeiner, D. C., W.F. Laudenslayer, and K.E. Mayer. 1988. California's wildlife. Volume I: amphibians and reptiles. California Department of Fish and Game, Sacramento, California.

Zweifel, R.G. 1955. Ecology, distribution, and systematics of frogs of the *Rana boylei* group. University of California Publications in Zoology 54:207-292.

Appendix A. SNFPA Standards and Guidelines that apply to Sierra Nevada Yellow-legged Frog, N DPS mountain yellow-legged frog, and Yosemite Toad			
	Num.	**Standard and Guideline**	**Associated Activity**
Standard and Guidelines that Apply to All Land Allocations			
	51	Grazing utilization in annual grasslands will maintain a minimum of 60 percent cover. Where grasslands are in satisfactory condition and annual precipitation is greater than 10 inches, manage for 700 pounds residual dry matter (RDM) per acre. Where grasslands are in satisfactory condition and annual precipitation is less than 10 inches, manage for 400 pounds RDM per acre. Where grasslands are in unsatisfactory condition and annual precipitation is greater than 10 inches, manage for 1,000 pounds RDM per acre; manage for 700 pounds RDM per acre where grasslands are in unsatisfactory condition and precipitation is less than 10 inches. Adjust these standards, as needed, based on grassland condition. This standard and guideline only applies to grazing utilization.	Rangeland Management
	52	Where professional judgment and quantifiable measurements find that current practices are maintaining range in good to excellent condition, the grazing utilization standards above may be modified to allow for the Forest Service, in partnership with individual permittees, to rigorously test and evaluate alternative standards.	Rangeland Management
	53	Exclude livestock from standing water and saturated soils in wet meadows and associated streams and springs occupied by Yosemite toads or identified as "essential habitat" in the conservation assessment for the Yosemite toad during the breeding and rearing season (through metamorphosis). Wet meadow habitat for Yosemite toads is defined as relatively open meadows with low to moderate amounts of woody vegetation that have standing water on June 1 or for more than 2 weeks following snow melt. Specific breeding and rearing season dates will be determined locally. If physical exclusion of livestock is impractical, then exclude grazing from the entire meadow. This standard does not apply to pack and saddle stock.	Rangeland Management
	54	Exclusions in standard and guideline #53 above may be waived if an interdisciplinary team has developed a site-specific management plan to minimize impacts to the Yosemite toad and its habitat by managing the movement of stock around wet areas. Such plans are to include a requirement for systematically monitoring a sample of occupied Yosemite toad sites within the meadow to: (1) assess habitat conditions and (2) assess Yosemite toad occupancy and population dynamics. Every 3 years from the date of the plan, evaluate monitoring data. Modify or suspend grazing if Yosemite toad	Rangeland Management

		conservation is not being accomplished. Plans must be approved by the authorized officer and incorporated into all allotment plans and/or special use permits governing use within the occupied habitat.	
	55	Complete one survey cycle in suitable habitat for the Yosemite toad within this species' historic range to determine presence of Yosemite toads.	
	64	Ensure that plans of operation, reclamation plans, and reclamation bonds address the costs of: (1) removing facilities, equipment, and materials; (2) isolating and neutralizing or removing toxic or potentially toxic materials; (3) salvaging and replacing topsoil; and (4) preparing the seed bed and revegetating to meet the objectives of the land allocation in which the operation is located.	Mining
	65	Ensure that mine owners and operators limit new road construction, decommission unnecessary roads, and maintain needed roads consistent with Forest Service roads policy and management direction for the land allocation.	Mining
	66	Require mine reclamation to be conducted in a timely manner.	Mining
	67	Inspect and monitor mining-related activities on a regular basis to ensure compliance with laws, regulations, and operating plans. Base the frequency of inspections and monitoring on the potential severity of mining activity-related impacts.	Mining
	68	During mining-related activities, limit the clearing of trees and other vegetation to the minimum necessary. Clearing of vegetation should be pertinent to the approved phase of mineral exploration and development.	Mining
	69	Prohibit wheeled vehicle travel off of designated routes, trails, and limited off highway vehicle (OHV) use areas. Unless otherwise restricted by current forest plans or other specific area standards and guidelines, cross-country travel by over-snow vehicles would continue.	Road and Trail System
	70	To protect watershed resources, meet the following standards for road construction, road reconstruction, and road relocation: (1) design new stream crossings and replacement stream crossings for at least the 100-year flood, including bedload and debris; (2) design stream crossings to minimize the diversion of streamflow out of the channel and down the road in the event of a crossing failure; (3) design stream crossings to minimize disruption of natural hydrologic flow paths, including minimizing diversion of streamflow and interception of surface and subsurface water; (4) avoid wetlands or minimize effects to natural flow patterns in wetlands; and (5) avoid road construction in meadows.	Road and Trail System
Standard and Guidelines For Riparian Conservation Areas and Critical Aquatic Refuges			

	91	Designate riparian conservation area (RCA) widths as described in Part B of this appendix. The RCA widths displayed in Part B may be adjusted at the project level if a landscape analysis has been completed and a site-specific RCO analysis demonstrates a need for different widths.	All
	92	Evaluate new proposed management activities within CARs and RCAs during environmental analysis to determine consistency with the riparian conservation objectives at the project level and the AMS goals for the landscape. Ensure that appropriate mitigation measures are enacted to (1) minimize the risk of activity-related sediment entering aquatic systems and (2) minimize impacts to habitat for aquatic- or riparian-dependent plant and animal species.	All
	93	Identify existing uses and activities in CARs and RCAs during landscape analysis. At the time of permit reissuance, evaluate and consider actions needed for consistency with RCOs.	All
	94	As part of project-level analysis, conduct peer reviews for projects that propose ground-disturbing activities in more than 25 percent of the RCA or more than 15 percent of a CAR.	All
Standards and Guidelines for Critical Aquatic Refuges			
	123	Determine which critical aquatic refuges or areas within critical aquatic refuges are suitable for mineral withdrawal. Propose these areas for withdrawal from location and entry under U.S. mining laws, subject to valid existing rights, for a term of 20 years.	Mining
	124	Approve mining-related plans of operation if measures are implemented that contribute toward the attainment or maintenance of aquatic management strategy goals.	Mining
Standards and Guidelines Associated with RCO #1			
	95	For waters designated as "Water Quality Limited" (Clean Water Act Section 303(d)), participate in the development of Total Maximum Daily Loads (TMDLs) and TMDL Implementation Plans. Execute applicable elements of completed TMDL Implementation Plans.	All
	96	Ensure that management activities do not adversely affect water temperatures necessary for local aquatic- and riparian-dependent species assemblages.	All
	97	Limit pesticide applications to cases where project level analysis indicates that pesticide applications are consistent with riparian conservation objectives.	Vegetation Management, Roads and Trail System, Recreation Management, Range

			Management, Invasive Species Management,
	98	Within 500 feet of known occupied sites for the California red-legged frog, Cascades frog, Yosemite toad, foothill yellow-legged frog, mountain yellow-legged frog, and northern leopard frog, design pesticide applications to avoid adverse effects to individuals and their habitats.	Vegetation Management, Roads and Trail System, Recreation Management, Range Management, Invasive Species Management,
	99	Prohibit storage of fuels and other toxic materials within RCAs and CARs except at designated administrative sites and sites covered by a Special Use Authorization. Prohibit refueling within RCAs and CARs unless there are no other alternatives. Ensure that spill plans are reviewed and up-to-date.	Vegetation Management, Roads and Trail System, Recreation Management, Range Management, Invasive Species Management
Standards and Guidelines Associated with RCO #2			
	100	Maintain and restore the hydrologic connectivity of streams, meadows, wetlands, and other special aquatic features by identifying Road and Trail System that intercept, divert, or disrupt natural surface and subsurface water flow paths. Implement corrective actions where necessary to restore connectivity.	Road and Trail System

	101	Ensure that culverts or other stream crossings do not create barriers to upstream or downstream passage for aquatic-dependent species. Locate water drafting sites to avoid adverse effects to in stream flows and depletion of pool habitat. Where possible, maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows, wetlands, and other special aquatic features.	Road and Trail System
	102	Prior to activities that could adversely affect streams, determine if relevant stream characteristics are within the range of natural variability. If characteristics are outside the range of natural variability, implement mitigation measures and short-term restoration actions needed to prevent further declines or cause an upward trend in conditions. Evaluate required long-term restoration actions and implement them according to their status among other restoration needs.	All
	103	Prevent disturbance to streambanks and natural lake and pond shorelines caused by resource activities (for example, livestock, off-highway vehicles, and dispersed recreation) from exceeding 20 percent of stream reach or 20 percent of natural lake and pond shorelines. Disturbance includes bank sloughing, chiseling, trampling, and other means of exposing bare soil or cutting plant roots. This standard does not apply to developed recreation sites, sites authorized under Special Use Permits and designated off-highway vehicle routes.	Vegetation Management, Road and Trail System, Recreation Management, Range Management
	104	In stream reaches occupied by, or identified as "essential habitat" in the conservation assessment for, the Lahonton and Paiute cutthroat trout and the Little Kern golden trout, limit streambank disturbance from livestock to 10 percent of the occupied or "essential habitat" stream reach. (Conservation assessments are described in the record of decision.) Cooperate with State and Federal agencies to develop streambank disturbance standards for threatened, endangered, and sensitive species. Use the regional streambank assessment protocol. Implement corrective action where disturbance limits have been exceeded.	All
	105	At either the landscape or project-scale, determine if the age class, structural diversity, composition, and cover of riparian vegetation are within the range of natural variability for the vegetative community. If conditions are outside the range of natural variability, consider implementing mitigation and/or restoration actions that will result in an upward trend. Actions could include restoration of aspen or other riparian vegetation where conifer encroachment is identified as a problem.	All

	106	Cooperate with Federal, Tribal, State and local governments to secure in stream flows needed to maintain, recover, and restore riparian resources, channel conditions, and aquatic habitat. Maintain in stream flows to protect aquatic systems to which species are uniquely adapted. Minimize the effects of stream diversions or other flow modifications from hydroelectric projects on threatened, endangered, and sensitive species.	
	107	For exempt hydroelectric facilities on national forest lands, ensure that special use permit language provides adequate in stream flow requirements to maintain, restore, or recover favorable ecological conditions for local riparian- and aquatic-dependent species.	
Standard and Guideline Associated with RCO #3			
	108	Determine if the level of coarse large woody debris (CWD) is within the range of natural variability in terms of frequency and distribution and is sufficient to sustain stream channel physical complexity and stability. Ensure proposed management activities move conditions toward the range of natural variability.	All
Standards and Guidelines Associated with RCO #4			
	109	Within CARs, in occupied habitat or "essential habitat" as identified in conservation assessments for threatened, endangered, or sensitive species, evaluate the appropriate role, timing, and extent of prescribed fire. Avoid direct lighting within riparian vegetation; prescribed fires may back into riparian vegetation areas. Develop mitigation measures to avoid impacts to these species whenever ground-disturbing equipment is used.	Vegetation Management
	110	Use screening devices for water drafting pumps. (Fire suppression activities are exempt during initial attack.) Use pumps with low entry velocity to minimize removal of aquatic species, including juvenile fish, amphibian egg masses and tadpoles, from aquatic habitats.	Vegetation Management, Road and Trail System
	111	Design prescribed fire treatments to minimize disturbance of ground cover and riparian vegetation in RCAs. In burn plans for project areas that include, or are adjacent to RCAs, identify mitigation measures to minimize the spread of fire into riparian vegetation. In determining which mitigation measures to adopt, weigh the potential harm of mitigation measures, for example fire lines, against the risks and benefits of prescribed fire entering riparian vegetation. Strategies should recognize the role of fire in ecosystem function and identify those instances where fire suppression or fuel management actions could be damaging to habitat or long-term function of the riparian community.	Vegetation Management

	112	Post-wildfire management activities in RCAs and CARs should emphasize enhancing native vegetation cover, stabilizing channels by non-structural means, minimizing adverse effects from the existing road network, and carrying out activities identified in landscape analyses. Post-wildfire operations shall minimize the exposure of bare soil.	Vegetation Management, Road and Trail System, Fire Suppression
	113	Allow hazard tree removal within RCAs or CARs. Allow mechanical ground disturbing fuels treatments, salvage harvest, or commercial fuelwood cutting within RCAs or CARs when the activity is consistent with RCOs. Utilize low ground pressure equipment, helicopters, over the snow logging, or other non-ground disturbing actions to operate off of existing roads when needed to achieve RCOs. Ensure that existing roads, landings, and skid trails meet Best Management Practices. Minimize the construction of new skid trails or roads for access into RCAs for fuel treatments, salvage harvest, commercial fuelwood cutting, or hazard tree removal.	Vegetation Management
	114	As appropriate, assess and document aquatic conditions following the Regional Stream Condition Inventory protocol prior to implementing ground disturbing activities within suitable habitat for California red-legged frog, Cascades frog, Yosemite toad, foothill and mountain yellow-legged frogs, and northern leopard frog.	
	115	During fire suppression activities, consider impacts to aquatic- and riparian-dependent resources. Where possible, locate incident bases, camps, helibases, staging areas, helispots, and other centers for incident activities outside of RCAs or CARs. During pre-suppression planning, determine guidelines for suppression activities, including avoidance of potential adverse effects to aquatic- and riparian-dependent species as a goal.	Fire Suppression
	116	Identify roads, trails, OHV trails and staging areas, developed recreation sites, dispersed campgrounds, special use permits, grazing permits, and day use sites during landscape analysis. Identify conditions that degrade water quality or habitat for aquatic and riparian-dependent species. At the project level, evaluate and consider actions to ensure consistency with standards and guidelines or desired conditions.	Road and Trail System, Recreation Management, Range Management
Standards and Guidelines Associated with RCO #5			

	117	Assess the hydrologic function of meadow habitats and other special aquatic features during range management analysis. Ensure that characteristics of special features are, at a minimum, at Proper Functioning Condition, as defined in the appropriate Technical Reports (or their successor publications): (1) "Process for Assessing PFC" TR 1737-9 (1993), "PFC for Lotic Areas" USDI TR 1737-15 (1998) or (2) "PFC for Lentic Riparian-Wetland Areas" USDI TR 1737-11 (1994).	Permitted Uses (Grazing)
	118	Prohibit or mitigate ground-disturbing activities that adversely affect hydrologic processes that maintain water flow, water quality, or water temperature critical to sustaining bog and fen ecosystems and plant species that depend on these ecosystems. During project analysis, survey, map, and develop measures to protect bogs and fens from such activities as trampling by livestock, pack stock, humans, and wheeled vehicles. Criteria for defining bogs and fens include, but are not limited to, presence of: (1) sphagnum moss (Spagnum spp.), (2) mosses belonging to the genus Meessia, and (3) sundew (Drosera spp.) Complete initial plant inventories of bogs and fens within active grazing allotments prior to re-issuing permits.	All
	119	Locate new facilities for gathering livestock and pack stock outside of meadows and riparian conservation areas. During project-level planning, evaluate and consider relocating existing livestock facilities outside of meadows and riparian areas. Prior to re-issuing grazing permits, assess the compatibility of livestock management facilities located in riparian conservation areas with riparian conservation objectives.	Range Management
	120	Under season-long grazing:	Range Management
		• For meadows in early seral status: limit livestock utilization of grass and grass-like plants to 30 percent (or minimum 6-inch stubble height).	
		• For meadows in late seral status: limit livestock utilization of grass and grass-like plants to a maximum of 40 percent (or minimum 4-inch stubble height).	
		Determine ecological status on all key areas monitored for grazing utilization prior to establishing utilization levels. Use Regional ecological scorecards and range plant list in regional range handbooks to determine ecological status. Analyze meadow ecological status every 3 to 5 years. If meadow ecological status is determined to be moving in a downward trend, modify or suspend grazing. Include ecological status data in a spatially explicit Geographical Information System database.	

		Under intensive grazing systems (such as rest-rotation and deferred rotation) where meadows are receiving a period of rest, utilization levels can be higher than the levels described above if the meadow is maintained in late seral status and meadow-associated species are not being impacted. Degraded meadows (such as those in early seral status with greater than 10 percent of the meadow area in bare soil and active erosion) require total rest from grazing until they have recovered and have moved to mid- or late seral status.	
	121	Limit browsing to no more than 20 percent of the annual leader growth of mature riparian shrubs and no more than 20 percent of individual seedlings. Remove livestock from any area of an allotment when browsing indicates a change in livestock preference from grazing herbaceous vegetation to browsing woody riparian vegetation.	Range Management
Standard and Guideline Associated with RCO #6			
	122	Recommend restoration practices in: (1) areas with compaction in excess of soil quality standards, (2) areas with lowered water tables, or (3) areas that are either actively down cutting or that have historic gullies. Identify other management practices, for example, road building, recreational use, grazing, and timber harvest, that may be contributing to the observed degradation.	All

Appendix B. Vegetation Management Best Hydrologic Management Practices (BMPs). Includes Measures from Timber Management (12.11), Vegetation Manipulation (12.51), Fuels Management (12.61), and Watershed Restoration (12.71) – ***Summary of R5 FSH 2509.22 - SOIL AND WATER CONSERVATION HANDBOOK, CHAPTER 10 - WATER QUALITY MANAGEMENT HANDBOOK; Amendment No.:*** *2509.22-2011-1;* ***Effective Date:*** *December 5, 2011*

BMP #	Title	Objective	Summary Explanation	Implementation
1.1	Timber Sale Planning Process	Incorporate water-quality and hydrologic considerations	Address potential water-quality problems and provide for administrative controls, corrective treatments, and preventive measures	Earth scientists or other trained and qualified individuals evaluate onsite watershed characteristics and potential environmental consequences of the proposed timber harvest and related activities. They design the timber sale to include site-specific prescriptions for each area of water-quality concern.
1.2	Harvest Unit Design	Ensure favorable conditions of water quality and quantity. Maintain desirable stream channel characteristics & watershed conditions. Consider size and distribution of natural structures (snag and down logs) to prevent erosion and sedimentation.	Characteristics to be evaluated include recovery from past harvests; size & extent of past management activities; protection of channels; number, size & location of harvest units; planned location & size of roads, landings and skid trails; logging system design; potential natural recovery rate of the watershed; & needs of associated beneficial uses. Where it is not possible to mitigate adverse effects on water quality & undesirable streamflow conditions, the harvest unit design will be modified to reduce adverse effects.	Earth scientists or qualified specialists will conduct a hydrologic and geologic survey of the area affected by proposed harvest activities. Mitigations or changes needed to stabilize slopes and project or improve stream courses will be incorporated into the harvest unit design.
1.3	Determine Surface Erosion Hazard	Identify high-erosion hazard areas to adjust treatment measures and prevent downstream water-quality degradation.	The California Soil Survey Committee erosion hazard rating (EHR)[1] system is used to estimate potential erosion hazard of a given area. It evaluates the soil-topography-climate-soil cover relationships of site-specific areas. Where the post-harvest hazard is predicted to be "moderate," an onsite evaluation is conducted to determine need for erosion control measures. Where the post-harvest hazard is predicted to be "high," or "very high," erosion-control	Erosion-hazard determination is part of the pre-sale planning process. Only trained & qualified Forest Service employees will establish the EHR for individual harvest units.

BMP #	Title	Objective	Summary Explanation	Implementation
			measures are necessary to reduce potential risk of accelerated erosion to a low or moderate level.	
1.4	Water Quality Protection Needs	Map areas to be protected for water-quality.	Includes: The location of streamcourses and riparian zones, including the width of the protection zone required for each stream; wetlands (meadows, lakes, springs, etc.) ; boundaries of harvest units; specified roads; roads where log hauling is prohibited, or restricted; structural improvement; area of different skidding and/or yarding method application; sources of rock for road work, riprapping, and borrow materials; water sources available for use; other features that are required by contract provisions; and site preparation/fuel treatment.	Identify and delineate these and other features on maps. The sale administrator and the purchaser will review these areas on the ground before commencing harvest.
1.5	Limited Operating Period	Ensure that operations, including, erosion-control work, road maintenance, etc., are conducted during periods when negative impacts to resources may be avoided.	Contract clause C6.313, "Limited Operating Period," will be used in a contract to limit the purchaser's operation to specified periods when adverse environmental effects are unlikely. Contract provision B6.6 can be used to close down operations due to the rainy season, high water, and other adverse operating conditions, to protect resources.	During the timber sale planning process, the interdisciplinary team will identify and recommend limited operating periods.
1.6	Protect Unstable Lands	Provide special treatment of unstable areas to avoid triggering mass slope failure with resultant erosion and sedimentation.	Using existing harvest technologies, unstable areas cannot be managed for timber production where irreversible adverse effects to soils, productivity, or watershed conditions may occur. Timber harvesting is deferred pending technology development proven to be operational on these sites without causing adverse environmental effects.	The interdisciplinary team will examine unstable lands. Where they are presently classified as suitable forest lands, the classification is changed to unsuitable forest lands. Unsuitable forest lands will not be harvested until they can be harvested without irreversible or unmitigable resource effects.
1.7	Establishing Size and Shape of Regeneration Harvest Units	Control the physical size & shape of regeneration harvest units as a means of preventing erosion and sedimentation.	Insure that clearcutting, seed tree cutting, shelterwood cutting and other cuts designed to regenerate an even aged stand of timber will be used only where size limits are established according to geographic areas, forest types, or other suitable	The size and the shape of the proposed regeneration units are reviewed on the ground in the pre-sale planning process.

BMP #	Title	Objective	Summary Explanation	Implementation
			classifications. Such cuts are carried out in a manner consistent with the protection of soil, watershed, fish, wildlife, recreation, esthetic resources, & the regeneration of the timber resource.	
1.8	Streamside Management Zone Designation	Designate a zone along riparian areas, streams, & wetlands that will minimize potential for adverse effects from adjacent management activities. Management activities within these zones are designed to improve riparian values.	As a preventive measure, roads, skid trails, landings, & other timber-harvesting facilities will be kept at a prescribed distance from designated stream courses. Factors such as stream class, channel aspect, channel stability, sideslope steepness, and slope stability are considered in determining the limitations on activities within the width of streamside management zones (SMZ). Aquatic and riparian habitat, beneficial riparian zone functions, their condition & their estimated response to the proposed timber sale are also evaluated in determining the need for and width of the streamside management zones. The SMZ will be a zone of total exclusion of activity, or a zone of closely managed activity that acts as an effective filter and absorptive zone for sediment; maintains shade; protects aquatic and terrestrial riparian habitats; protects channel and streambanks; & promotes floodplain stability.	Identify the streamside management zone requirements during the environmental documentation process. The timber sale contract will be designed to ensure retention of streamside vegetation and improve the condition and beneficial functions of the riparian area. As appropriate, water-quality monitoring will be identified in the environmental document.
1.9	Determine Areas Suitable for Tractor Logging	Minimize erosion and sedimentation resulting from ground disturbance of tractor logging systems.	Minimize accelerated soil erosion and sedimentation, and water-quality degradation. To determine tractor-loggable ground, consider physical site characteristics such as steepness of slopes, landslide prone areas, and soil properties. The EHR is one method. For example, where the post-tractor logging EHR is predicted to be "moderate," an onsite evaluation is conducted to determine the need for erosion-control measures. Where the post-tractor logging EHR is predicted to be "high," or "very	A trained and qualified Forest Service employee will evaluate the EHR[1] during the on-the-ground planning phase of the timber sale. This work is done within each sale area by evaluating representative sites. The resulting EHRs are considered during the selection of logging methods and silvicultural prescriptions, of erosion-control measures to reduce risk, and in determining the intensity of and controls for land-disturbing activities.

BMP #	Title	Objective	Summary Explanation	Implementation
			high," erosion-control measures are required to reduce the risk of accelerated erosion. Avoid tractor logging where the predicted, post-logging erosion hazard cannot be reduced to either "low" or "moderate."	
1.10	Tractor Skidding Design	Minimize erosion and sedimentation by designing skidding patterns to best fit the terrain, the volume, velocity, concentration, and direction of runoff water.	Watershed factors considered include slope, soil stability, exposure, SMZs, meadows, and other factors that may affect the surface water runoff and sediment yield potential of the land. The careful control of skidding patterns serves to avoid onsite and downstream channel instability, build-up of destructive runoff flows, and erosion in sensitive watershed areas such as meadows and SMZs	For skid trail design, sensitive areas will be identified and evaluated in the environmental documentation process during the timber sale planning process. When needed to protect water quality, prescriptions must be included in the basic timber sale contract.
1.11	Suspended Log Yarding	Protect the soil mantle from excessive disturbance; maintain the integrity of the SMZ and other sensitive watershed areas; control erosion on cable corridors.	Suspended log yarding includes all yarding systems that suspend logs either partially or completely off the ground. These systems include, but are not limited to, skyline, helicopter, and balloon yarders. The systems are used on steep slopes where tractors cannot operate. All of the systems result in less soil disturbance since heavy machinery is not used over the sale area. Erosion-control measures are applied as necessary in cable corridors to control erosion and runoff.	The areas where suspended log yarding is required will be determined during the pre-sale planning process, and they will be included in the sale plan.
1.12	Log Landing Location	Locate new landings or reuse old landings in such a way as to avoid watershed impacts and associated water-quality degradation.	To the extent feasible: select landing locations that involve the least amount of excavation and the least erosion potential, and are well outside of the SMZ; locate landings near ridges away from headwater swales in areas that will allow skidding without crossing channels, violating the SMZ, or causing direct deposit of soil and debris to the stream. Locate landings where the least number of skid roads will be required, and sidecast can be stabilized without entering drainages, or affecting other sensitive areas. Position landings such that the skid road approach	The sale administrator must agree to landing locations proposed by the purchaser or their representatives. Relying on interdiscipliinary team input and the stated criteria, the sale administrator can negotiate to select mutually acceptable landing locations—other than those identified in the NEPA document. To be an acceptable landing, it must meet the above criteria. Should agreement not be reached, the decision of the Forest Service will prevail within contract limitations.

BMP #	Title	Objective	Summary Explanation	Implementation
			will be as nearly level as feasible, to promote safety, and protect the soil from erosion. Keep to a minimum the number of skid trails entering a landing. Avoid excessive fills associated with landings constructed on old landslide benches. Do not change the mass balance to point to destabilize the landslide. Construct stable landing fills or improve existing landings by using appropriate compaction and drainage specifications. Engineered fills will be needed under certain conditions.	
1.13	Measures to Prevent and Control Erosion During Timber Sale Operations	Ensure that the purchasers' operations will be conducted reasonably to minimize soil erosion.	Timber is purchased by individuals or companies who either harvest the timber themselves, or sub-contract to other parties. Therefore, it is necessary to ensure that purchasers and their sub-contractors understand and adhere to water-quality BMP prescriptions formulated during the timber sale planning process. This is accomplished by setting forth the purchaser's responsibilities in the timber sale contract, and holding the purchaser accountable for actions of their sub-contractor.	Equipment will not be operated when ground conditions are such that excessive damage will result. The kinds and intensity of control work required of the purchaser will be adjusted to ground and weather conditions, with emphasis on the need to control overland runoff, erosion, and sedimentation. Erosion-control work required by the contract will be kept current. At certain times of the year this means daily, if precipitation is likely, or at least weekly when precipitation is predicted for the weekend.
1.14	Special Erosion Preventing Measures on Disturbed Land	Provide appropriate erosion and sedimentation protection for disturbed areas.	When required by the contract, the purchaser will give adequate treatment by spreading slash, mulch, or wood chips (or, by agreement, some other treatment) on portions of tractor roads, skid trails, landings, cable corridors or temporary road fills.	During the timber sale planning process and/or during sale appraisal, the interdisciplinary team will identify criteria for selecting treatment areas or classes of areas for special treatment and document them in the environmental assessment.
1.15	Revegetation of Areas Disturbed by Harvest Activities	Establish a vegetative ground cover on disturbed sites to prevent erosion and sedimentation.	Where the purchaser's operations have severely disturbed the soil, and the establishment of vegetation is needed to control accelerated erosion, the purchaser will be required to take appropriate measures normally used to establish an adequate ground cover of grass or other vegetative stabilization measures acceptable to the Forest	The Forest Service will include an estimate of the need for revegetation in the timber sale appraisal and sale contract. Where revegetation is prescribed, the prescription must be included in the timber sale contract. The sale administrator will designate the areas of disturbed soils, such as

BMP #	Title	Objective	Summary Explanation	Implementation
			Service. The type and intensity of treatment to establish ground cover is prescribed by the sale administrator, with assistance from earth scientists and botanists, as needed.	logging areas and temporary roads that must be treated. The Forest Service will provide advice as to soil preparation and the application of suitable seed mixtures, mulch, and fertilizer, and the timing of such work.
1.16	Log Landing Erosion Control	Reduce the impacts of erosion and subsequent sedimentation associated with log landings by use of mitigating measures.	The Sale Planning Forester and sale administrator assess the need for stabilization, with the assistance of earth scientists as needed.	Timber sale contract requirements provide for erosion prevention and control measures on all landings. The Timber Sale Preparation Forester will include provisions in the timber sale contract for landings to have proper drainage. After landings have served the purchaser's purpose, the purchaser will ditch, or slope the landings, and may be required to rip or subsoil and make provisions for revegetation to permit the drainage and dispersion of water. Erosion-prevention measures such as waterbars will be constructed to divert water away from landings. Other provisions may include aggregate surfacing; scarifying; smoothing and sloping; construction of drainage ditches; spreading slash; covering with mulch or wood chips; or applying straw mulch. Prevent road drainage from reaching landings. Unless agreed otherwise, cut and fill banks around landings will be reshaped to stabilize the area. The specific work needed on each landing will depend on the actual onsite conditions

BMP #	Title	Objective	Summary Explanation	Implementation
1.17	Erosion Control on Skid Trails	Protect water quality by minimizing erosion and sedimentation derived from skid trails.	The timber sale contract requires the installation of erosion-control measures on skid trails, tractor roads, and temporary roads. Normally, the work involves constructing cross ditches and water-spreading ditches. Other methods such as backblading will be agreed to in lieu of cross drains. Grass seeding or other erosion-control and compaction remediation measures may also be required.	Locations of all erosion-control measures are designated. The sale administrator handbook section on Skid Trails and Firelines contains guidelines for spacing of cross drains, construction techniques, and cross drain heights. The sale administrator should use these guidelines on the ground to identify site-specific preventive work that is required of the purchaser who is obligated to complete and maintain erosion-control work specified in contract provisions during the life of the contract.
1.18	Meadow Protection	Avoid damage to the ground cover, soil, and the hydrologic function of meadows	As a minimum, meadow protection requirements contained in the forest LRMP must be identified and implemented. Trained and qualified Forest Service employees will assess these areas. Protection zones and tree directional felling are prescribed according to site conditions and within guidelines provided by the Forest Service directive system and the LRMP guidelines. The timber sale contract prohibits unauthorized operation of vehicular or skidding equipment in meadows or in protection zones designated on sale area maps and marked on the ground. Vehicular or skidding equipment is not to be used on meadows except when specifically approved by the sale administrator. Where feasible, directional felling will be used to avoid felling trees into meadows. Unless otherwise agreed, trees felled into meadows will be removed by end-lining, slash removed, and resulting disturbance will be repaired where necessary to protect vegetative cover, soil, and water quality.	The contract may also specify that a purchaser is subject to liquidated damage charges each time equipment enters a designated meadow. The purchaser will repair damage to these designated areas and/or their associated protection zones in a timely manner, as agreed to by the sale administrator. The purchaser will repair damage to a streamcourse, or SMZs caused by unauthorized purchasers' operations in a timely and agreed-upon manner.

BMP #	Title	Objective	Summary Explanation	Implementation
1.19	Stream-course and Aquatic Protection	Conduct management actions within these areas in a manner that maintains or improves riparian and aquatic values. Provide unobstructed passage of stormflows. Control sediment and other pollutants entering streamcourses. Restore the natural course of any stream as soon as practicable, where diversion of the stream has resulted from timber management activities.	Nine Principles fundamental to protecting streamcourses: Identification and location and method of streamcourse crossings prior to construction; any damage to a streamcourse, including damage to banks and channels, will be repaired to the extent practicable; all sale-generated debris is removed from streamcourses, unless otherwise agreed to by the sale administrator, and in an agreed-upon manner that will cause the least disturbance; limit, or exclude equipment use in designated SMZs. Widths of SMZ and restrictions pertaining to equipment use are defined by onsite project investigation and are included in the timber sale contract; methods for protecting water quality while utilizing tractor skid trail design in streamcourse areas where harvest is approved include: 1) end lining, 2) felling to the lead, and 3) utilizing specialized equipment with low ground pressure such as a feller buncher harvester; water bars and other erosion-control structures will be located so as to disperse concentrated flows and filter out suspended sediments prior to entry into streamcourse; Material from temporary road and skid trail streamcourse crossings is removed and streambanks restored to the extent practicable; In cable log yarding operations, logs will be fully airborne within the SMZ, when required by the timber sale contract; and special slash-treatment site-preparation activities will be prescribed in sensitive areas to facilitate slash disposal without use of mechanized equipment.	The sale administrator works with the purchaser's representative to ensure that the timber sale contract clauses covering the above items are carried out on the ground. Specialists can be called upon to help the sale administrator with decisions. In the event the purchaser causes debris to enter streamcourses in amounts which may adversely affect the natural flow of the stream, water quality, or fishery resource, the purchaser will remove such debris as soon as practicable, but not to exceed 48 hours, and in an agreed-upon manner that will cause the least disturbance to streamcourses.
1.20	Erosion Control Structure	Ensure that constructed erosion-control structures are stabilized and	Erosion-control structures are only effective when they are in good repair and function as designed. Once the erosion-control structures are constructed,	During the period of the timber sale contract, the purchaser will provide maintenance of soil erosion-control structures constructed by the purchaser

BMP #	Title	Objective	Summary Explanation	Implementation
	Maintenance	working.	there is a possibility that they may not become adequately effective, or they will become damaged from subsequent harvest activities. It is necessary to provide follow-up inspection and structural maintenance to avoid these problems and ensure adequate erosion control.	until they become stabilized, but not for more than one year after their construction. After one year, accomplish needed erosion-control maintenance work using other funding sources under timber sale contract provisions B6.6 and B6.66.
1.21	USFS Acceptance of Erosion Control Work By Purchaser	Ensure the adequacy of required erosion-control work on timber sales.	The effectiveness of soil erosion prevention and control measures is determined by the conditions found after sale areas have been exposed for one, or more years to the elements. The evaluation is to ensure that erosion-control treatments are in good repair and functioning as designed before releasing the purchaser from the contract responsibility.	"Acceptable" erosion control means only minor deviation from established objectives, provided no major, or lasting damage is caused to soil, or water. Sale administrators will not accept erosion-control measures that fail to meet these criteria. Specific requirements for erosion control are included in each timber sale contract and the sale administrator handbook.
1.22	Slash Treatment in Sensitive Areas	Maintain or improve water quality by protecting sensitive areas from degradation which would likely result from using mechanized equipment for slash disposal.	Special slash treatment site preparation will be prescribed in sensitive areas to facilitate slash disposal without use of mechanized equipment. Meadows, wetlands, SMZs, and landslide areas are typically sensitive areas where equipment use is normally prohibited. Slash-treatment and site-preparation methods are specified in environmental documents, where applicable, for each cut unit in project and contract documents such as a timber sale contract, project map, or sale area map.	An assessment of the sale area will be made in the timber sale planning process. Sensitive areas requiring protection are identified. Assessment results will be documented in the environmental document, and identified in the timber sale contract and on the sale area map. The sale administrator, contract inspector, or Forest Service specialist will inspect the treatment for correct and satisfactory slash disposal accomplishment.
1.23	Five Year Reforestation Requirement	Assure a continuous forest cover and to limit disturbance on areas with limited regeneration potential where there is no assurance that the site can be reforested within 5 years.	When trees are cut to achieve timber production objectives, the cuttings shall be made in such a way as to assure that the technology and knowledge exists to adequately restock the lands within 5 years after harvest. Adequate stocking means that the cut area will contain the minimum number, size, distribution, and species composition of regeneration as specified in regional silvicultural guides for each forest type. Five years after final harvest means 5 years after	During the timber sale planning process, the interdiscipliinary team assesses the capability of proposed areas to achieve reforestation within the prescribed period. The silviculturist uses information the interdisciplinary team collected, including soil productivity, soil depth, and available moisture-holding capacity to determine harvesting and regeneration methods.

BMP #	Title	Objective	Summary Explanation	Implementation
			clear cutting, 5 years after final overstory removal in shelterwood cutting, 5 years after seed tree removal cut in seed tree cutting, or 5 years after selection cutting (36 CFR Part 219.27 (c) (3)). The implementation of this practice protects water quality by helping to stabilize soils, increasing ground cover, and providing improved infiltration.	
1.24	Special Water Quality Protection Contract Clauses	Use the option of creating and inserting Special "C" provisions in the timber sale contract to protect water quality where standard "B" or "C" provisions do not apply or are inadequate to protect watershed values.	An example of a Special "C" provision commonly used for water-quality protection is the provision concerning the directional felling of timber. This provision is used for SMZs where it is important to avoid felling trees into streams, or into important areas of riparian vegetation, or residual timber. Another example is the use of a "swing yarding" special provision in situations where such a method would help protect water quality. Swing yarding refers to the use of more than one yarding system to accomplish a difficult yarding problem. In one situation, it might be possible to avoid building a stream crossing by using a tractor to yard logs to a point where a skyline yarder could lift them across the stream to a landing.	The interdisciplinary team will identify and recommend the need for Special "C" provisions during the timber sale planning process. The Sale Preparation Forester will prepare documentation describing the Special "C" provision needed and submit it through line officers to the Regional Forester for approval. The Regional Forester will prepare the appropriate contract wording of the provision and return it approved. The sale administrator will apply the Special "C" provision in the same manner as the standard contract provisions.
1.25	Special Modification of Timber Sale Contracts	Modify the timber sale contract if new circumstances or conditions indicate that the timber sale will damage soil, water, or watershed values.	At times, it may be necessary to modify a timber sale contract because of new concerns about the potential effects of land disturbance on the water resource. The interdisciplinary team will report to the appropriate line officer on whether the timber sale as currently planned will (1) damage soil, water, or watershed conditions or (2) inadequately protect stream courses, streambanks, shorelines, lakes, wetlands, and other bodies of water from detrimental changes in water quality, and/or blockages of watercourses. The interdiscipliinary team will also recommend mitigation and corrective actions. The	Where the project is determined to unacceptably affect watershed values, the appropriate line officer will take corrective actions, which may include contract modification. The timber sale modification can be accomplished by agreement with the timber sale purchaser, or unilaterally by the Forest Service (with suitable compensation to the purchaser) using the amended environmental document prepared by the interdisciplinary team.

BMP #	Title	Objective	Summary Explanation	Implementation
			environmental document prepared for the timber sale will then be amended to reflect the findings of the interdiscipliinary team.	
5.1	Soil Disturbing Treatments on the Contour	Decrease sediment production and stream turbidity, while mechanically treating slopes.	This is a preventive measure that limits surface-disturbance activities, such as, but not limited to, disking, seed drilling, and windrowing, to preclude water from concentrating by providing means of adequate infiltration and by decreasing the velocity of surface runoff so infiltration is enhanced. Due to mechanical limitation of the equipment, slopes greater than 30 percent are usually not considered for this type of treatment. Factors evaluated are slope, infiltration rate, permeability, and water-holding capacity of the soil. Trained and qualified personnel make field evaluations of these factors as input to project planning.	Following NEPA procedures and using interdisciplinary team input, project planners will be responsible for formulating the appropriate contract provisions and/or mitigation measures for the contract, or project plans. The project leader will be responsible for enforcing management requirements and mitigation measures that deal with soil-disturbing treatments through force account projects. The contracting officer's representative will be responsible for enforcing provisions of the contract.
5.2	Slope limitations for Mechanical Equipment Operation	Reduce gully and sheet erosion and associated sediment production by limiting tractor use.	This is a preventive measure that limits excessive surface disturbance and keeps surface water from concentrating. This measure facilitates making allowances for proper drainage of disturbed areas by limiting tractor operation to slopes where corrective measures such as water bars can be effectively installed. Criteria used to determine slope restrictions are onsite evaluations of soil stability, mass stability and geology, climate conditions, and soil water-holding capacity. These field determinations will be made as part of the environmental documentation process during project planning.	Project planners will be responsible for ensuring that appropriate tractor operation provisions are included in the decision and activity-controlling documents. This practice will be implemented on vegetation-manipulation projects where determined to be appropriate by the interdisciplinary team.
5.3	Tractor Operation Limitation in Wetlands &	Limit turbidity and sediment production resulting from compaction, rutting,	This is a preventative practice designed to preclude the concentration of surface runoff and soil compaction, which can lead to rill and gully erosion	The application of this BMP will be mandatory on all vegetation-manipulation projects as prescribed in the environmental documentation.

BMP #	Title	Objective	Summary Explanation	Implementation
	Meadows	runoff concentration, and subsequent erosion by excluding the use of mechanical equipment in wetland and meadows except for the purpose of restoring wetland and meadow function.	with associated turbidity and sedimentation. This measure precludes, or reduces the need to take corrective measures to dissipate concentrated surface water runoff. Target areas will be protected from mechanical operations except when trained and qualified interdisciplinary team personnel identify the areas for treatment. Specific protection measures will be established for each area that could incur adverse water-quality impacts (see also BMP 1.18).	Project planners will be responsible for including appropriate contract specifications and identifying management requirements and mitigation measures in the project decision and implementation documents.
5.4	Revegetation of Surface-Disturbed Areas	Protect water quality by minimizing soil erosion through the stabilizing influence of vegetation foliage and root network.	This is a corrective practice to stabilize an otherwise unstable soil surface during vegetation-manipulation projects. The plant species selected will be a mix best suited for site conditions and attainment of multiple management objectives for the area. Native plant species will be used to the fullest extent feasible. Soil amendments and irrigation, along with application of mulch with tackifier, jute netting, or other supplement treatments may be necessary to ensure revegetation. Grass or browse species will be seeded between previously planted trees where deemed appropriate for control of overland runoff, and to meet wildlife needs. The onsite factors evaluated include soil productivity, topography, EHR[1], soil water-holding capacity, target species, environmentally associated species, and climatic variables. Evaluation includes the collection of onsite data, and office interpretation by the interdisciplinary team (see also BMP 1.15).	During the environmental documentation process, trained and qualified employees will assess the need for treatment, and prescribe the vegetative species mix for each project.
5.5	Disposal of Organic Debris	Prevent gully and surface erosion with associated reduction in sediment production and turbidity during and after	This is a preventive practice to reduce excessive volumes and velocities of overland flow, promote infiltration, and prevent wildfires from consuming excessive amounts of surface and soil organic matter	Project planners will be responsible for determining the method(s) of debris disposal and/or placement of debris after treatment. Methods of disposal include, but are not limited to: prescribed burning,

BMP #	Title	Objective	Summary Explanation	Implementation
		treatment.	and creating hydrophobic soil conditions. The interdisciplinary team will identify project controls and mitigation measures after evaluating such onsite factors as soil water-holding capacity, EHR, slope and topographic limitations, the quantity of debris: density and ratio of rearranged debris, residual ground cover density objectives, climatic variables, and the probability of creating water-repellant soils.	chipping and mulching, lop and scatter, and mechanical harvesting and collection.
5.6	Soil Moisture Limitations for Mechanical Equipment Operations	Prevent compaction, rutting, and gullying, with resultant sediment production and turbidity.	This is a preventive practice that reduces surface disturbance during wet soil conditions, which would result in compaction, rutting, and gullying. Soil moisture guidelines will be developed for each site, based on the characteristics of the soil. The project should then be conducted as guided by soil erodibility, climate factors, soil and water relationships, and mass stability hazards identified by trained and qualified earth scientists (see also BMP 1.5).	Soil conditions will be evaluated during the environmental documentation process and the interdisciplinary team will develop operating limitations as the alternatives are formulated. Project planners will be responsible for including appropriate contract provisions and management requirements in project work plans and environmental documentation. For force account projects, the project leader will be responsible for determining when the soil surface is unstable and susceptible to damage, and for terminating operations. The contracting officer's representative will determine when optimum soil conditions exist, and administer the operation to prevent adverse soil effects, in addition to suspending, or terminating operations for contracted projects as soil moisture conditions warrant.
5.7	Pesticide Use Planning Process	Introduce water quality and hydrologic considerations into the pesticide use planning process.	The pesticide use planning process is the framework for incorporating water-quality protection requirements contained in BMPs 5.8 through 5.14 into project design and management. The project environmental document will incorporate these considerations in discussion of environmental effects	The interdisciplinary team will evaluate the project in terms of site response, social and environmental impacts, and the intensity of monitoring needed.

BMP #	Title	Objective	Summary Explanation	Implementation
			and mitigation measures.	
5.8	Pesticide Application According to Label Directions & Applicable Legal Require-ments	Avoid water contamination by complying with all label instructions and restrictions for use.	Directions on the label of each pesticide are detailed and specific, and include legal requirements for use.	Constraints identified on the label and other legal requirements of application must be incorporated into project plans and contracts.
5.9	Pesticide Application Monitoring & Evaluation	Determine whether pesticides have been applied safely, were restricted to intended target areas, and have not resulted in unexpected non-target effects; document and provide early warning of hazardous conditions resulting from possible pesticide contamination of water or other non-target areas; and to determine the extent, severity, and duration of any potential hazard that might exist.	This practice documents the accuracy of application, amount applied, and any water-quality effects so as to reduce, or eliminate hazards to non-target species. Monitoring methods include spray cards, dye tracing (fluorometry), and direct measurement of particles in, or near water. Type of pesticide, type of equipment, application difficulty, public concern, beneficial uses, monitoring difficulty, availability of laboratory analysis, and applicable Federal, State, and local laws and regulations are all factors considered when developing the monitoring plan.	The need for a monitoring plan will be identified during the pesticide use planning process as part of the project environmental evaluation and documentation. The water-quality monitoring plan will specify: who will be involved and their roles and responsibilities; what parameters will be monitored and analyzed; when and where monitoring will take place; and what methodologies will be used for sampling and analysis, and the rationale behind each of the preceding specifications. A water-quality specialist and the project leader will evaluate and interpret the water-quality monitoring results in terms of compliance with and adequacy of project specifications.
5.10	Pesticide Spill Contingency Planning	Reduce contamination of water by accidental pesticide spills.	This is a preventative and corrective practice. The pesticide spill contingency plan prepared by each forest consists of predetermined actions to be implemented in the event of a pesticide spill. The plan lists who will notify whom and how, time requirements for the notification, guidelines for spill	Pesticide spill contingency planning will be incorporated into the project safety plan. The site-specific environmental evaluation and resulting documentation will include public and other agency involvement in plan preparation. The

BMP #	Title	Objective	Summary Explanation	Implementation
			containment, and who will be responsible for cleanup. Site-specific planning will be included in the project safety plan.	plan will list the responsible authorities.
5.11	Cleaning & Disposal of Pesticide Containers & Equipment	Prevent water contamination resulting from cleaning, or disposal of pesticide containers.	The cleaning and disposal of pesticide containers must be done in accordance with Federal, State, and local laws, regulations, and directives. Specific procedures for the cleaning and disposal of pesticide containers are documented in the Forest Service Pesticide Use Management and Coordination Handbook (FSH 2109.114), and State and local laws.	The forest, or district Pesticide Use Coordinator (Qualified Applicator) will approve proper rinsing procedures in accordance with State and local laws and regulations, and arrange for disposal of pesticide containers when Forest Service personnel apply the pesticide. When a contractor applies the pesticide, the contractor will be responsible for proper container rinsing and disposal in accordance with label directions and Federal, State, and local laws.
5.12	Streamside Wet Area Protection During Pesticide Spraying	Minimize the risk of pesticides inadvertently entering waters, or unintentionally altering the riparian area, SMZ, or wetland.	When spraying pesticides for the purpose of meeting non-riparian area land management objectives, an untreated strip of land and vegetation will be left alongside surface waters, wetlands, riparian areas, or SMZ. The interdisciplinary team will establish strip width and, when county permits are required, in consultation with the county agricultural commissioner. When spraying pesticides for purposes of meeting riparian-area land management objectives, localized buffers around target species will be established and only hand application will be used. Factors considered in establishing buffer strip widths are beneficial water uses, adjacent land uses, rainfall, wind speed, wind direction, terrain, slope, soils, and geology. The persistence, mobility, acute toxicity, bio-accumulation, and formulation of the pesticide are also considered. Equipment used, spray pattern, droplet size, and application height and past	The interdisciplinary team will identify the perennial and intermittent surface waters, wetlands, riparian areas, and SMZ from onsite observation, and map them during project planning. When included as part of the environmental evaluation and documentation, the project work plan, the protection of surface waters, wetlands, riparian areas, or the SMZ will be the responsibility of the project supervisor for force account projects, and the COR will be responsible on contracted projects. The certified applicators must be briefed about the location of surface waters, wetlands, riparian areas, or SMZ. Buffer strip boundaries will be flagged, or otherwise marked, when necessary, to aid identification from the air.

BMP #	Title	Objective	Summary Explanation	Implementation
			experience are other important factors.	
5.13	Controlling Pesticide Drift During Spray Application	Minimize the risk of pesticide falling directly into water, or non-target areas.	The spray application of pesticide is accomplished according to prescription which accounts for terrain and specifies the following: spray exclusion areas; buffer areas; and factors such as formulation, equipment, droplet size, spray height, application pattern, and flow rate; and the limiting factors of wind speed and direction, temperature, and relative humidity.	An interdisciplinary team will prepare the prescription, working with the Forest or District Pesticide Use Coordinator during project planning. For force account projects, the Forest Service project supervisor will be responsible for ensuring that the prescription is followed during application and for closing down application when specifications are exceeded. On contracted projects, the contracting officer, or the contracting officer's representative will be responsible for ensuring that the prescription is followed during application and for closing down application when specifications are exceeded.
6.1	Fire and Fuels Management Activities	Reduce public and private losses and environmental impacts which result from wildfires and/or subsequent flooding and erosion by reducing or managing the frequency, intensity, and extent of wildfire.	These administrative, corrective, and preventive measures include the use of prescribed fire or mechanical methods to achieve: defensive fuel profile zones; type conversions; greenbelt establishment to separate urban areas from wildlands; fuel reduction units; access roads and trails for rapid ingress and egress; fire-suppression activities; fuel utilization and modification programs; and public information and education programs.	Fuel management will be implemented through normal program planning and budgeting and NEPA processes, predominantly, but not exclusively, by personnel in the Forest Service fire management organization. Other resource managers, such as timber, range; watershed, and wildlife may initiate fuel-modification projects that also benefit fire management. Fuel-management projects will be evaluated by the interdisciplinary team. Management requirements, mitigation measures, and multiple resource-protection prescriptions are documented in the project-specific decision and implementation documents.
6.2	Consideratio n of Water Quality in	Provide for water-quality protection while achieving the	Prescription elements will include, but not be limited to, such factors as fire weather, slope, aspect, soil moisture, and fuel moisture. These elements	Field investigations will be conducted as required to identify site-specific conditions, which may affect

BMP #	Title	Objective	Summary Explanation	Implementation
	Formulating Fire Prescriptions	management objectives through the use of prescribed fire.	influence the fire intensity and thus have a direct effect on whether a desired ground cover remains after burning, and whether a water-repellent layer is formed. The prescription will include at the watershed- and subwatershed-scale the optimum and maximum burn block size, aggregate burned area, acceptable disturbance for contiguous and aggregate length for the riparian/SMZ; and expected fire return intervals and maximum expected area covered by water-repellant soils.	the prescription. Both the optimum and allowable limits for the burn to ensure water-quality protection will be established prior to preparation of the burn plan. An interdisciplinary team will assess the prescription elements and the optimum and maximum acceptable disturbance, and the fire management officer or fuel management specialist will prepare the fire prescription. The fire prescription will be reviewed by the interdisciplinary team and approved by the appropriate line officer.
6.3	Protection of Water Quality from Prescribed Burning Effects	Maintain soil productivity; minimize erosion; and minimize ash, sediment, nutrients, and debris from entering water bodies.	Some of the techniques used to prevent water-quality degradation are: constructing water bars in fire lines; reducing fuel loading in drainage channels; maintaining the integrity of the SMZ within the limits of the burn plan; planning prescribed fires for burn intensities so that when water-repellant soils are formed, they are within the limits and at locations described in the burn plan; and retaining or re-establishing ground cover as needed to keep erosion of the burned site within the limits of the burn plan.	Forest Service and other crews will be used to prepare the units for burning. This will include, but not be limited to, water barring firelines, reducing fuel concentrations, and moving fuel to designated disposal and burning areas. The interdisciplinary team will identify the SMZ and soils with high risk of becoming water-repellant as part of project planning.
7.1	Watershed Restoration	Repair degraded watershed conditions and improve water quality and soil stability.	Watershed restoration is a corrective measure to: improve ground cover density; improve infiltration; prevent excessive overland runoff and conserve the soil resource; stabilize stream banks and stream channels; improve soil productivity; reduce flood occurrence and flood damage; enhance economic, social and/or aesthetic values of the watershed; and improve overall watershed function. The following factors will be considered during development of restoration projects: predicted changes in water quality and any direct or indirect	This management practice is implemented through the development of a Watershed Improvement Needs (WIN) inventory, identification of projects, preparation and approval of restoration plans and related environmental documentation, and the funding and implementation of the restoration actions.

BMP #	Title	Objective	Summary Explanation	Implementation
			impacts on the beneficial uses of water, downstream values, site productivity, and threats to life and property. Watershed restoration measures will reflect the state-of-the-art and must be chosen to custom fit the unique hydrological, physical, biological, and climatic characteristics of each watershed. Examples of watershed-restoration measures are check dam installation, streambank and channel stabilization structures, soil scarification, and seeding and planting.	
7.2	Conduct Floodplain Hazard Analysis and Evaluation	Avoid, where possible, the long- and short-term adverse impacts to water quality associated with the occupancy and modification of floodplains.	Floodplain analysis and evaluation are part of the environmental documentation process. Analysis must be performed prior to acquisition or exchange of land within floodplains and when sites within floodplains are being considered for structures or developments. Environmental quality, ecological effects, and individual safety and health must be considered as well as flood frequencies, watershed conditions, climatic and environmental factors associated with past flood events, flood flow quantities and specific flood boundaries.	Implementation: The Regional Forester will be responsible for ensuring consideration of floodplain hazards and values in all NEPA environmental analysis. Ensure that flood hazards, floodplain and wetland values, and all alternatives that affect floodplain or that involves new construction in wetlands are fully considered in the Forest Service planning and decision-making process. Coordinate activities and interchange of floodplain and wetlands information with other concerned Federal and State agencies. Ensure that cooperative technical and financial assistance programs include an evaluation of floodplain and wetland values. Ensure that all documents conveying interest in or authorizing use of floodplains and wetlands on NFS lands contain disclosure of and/or restrictions as warranted which will reduce the risk of loss and preserve the national and beneficial values served by floodplains and wetlands. Analyze proposed actions affecting floodplains or involving new construction in wetlands to access the specific flood hazards, quantify floodplain or wetland values

BM P #	Title	Objective	Summary Explanation	Implementation
				of the areas; determine the impacts of the proposal on those hazards and values; formulate and evaluate land and resource management options; develop practicable alternative actions or locations for evaluation and decision making. In actions where an alternative affecting the floodplain or new construction in a wetland is not practicable, modify plans, activities, and designs to minimize impacts of the action and mitigate its effects on the national and beneficial values of the floodplain or wetland. Ensure that all practicable and necessary mitigation measures are incorporated in specifications for the proposed action, and that the implementation of the selected action is accomplished in a manner that to the extent practicable restores and preserves the natural and beneficial values served by the floodplains and preserves and enhances the natural and beneficial values of wetlands. Require flood hazard and wetland evaluations prior to issuing licenses, permits, loans, or grants-in-aid. Provide assistance to applicants in obtaining help to make such evaluations in their proposals. Ensure that design, construction or rehabilitation of Forest Service real property is in accordance with standards and criteria outlined in the National Flood Insurance Program (42 U.S.C. 4001 and following) using flood-proofing measures and structural elevation where practicable. Provide for the placement of appropriate signs to enhance public awareness and knowledge of flood hazards. Establish specific management standards and guidelines for

BMP #	Title	Objective	Summary Explanation	Implementation
				floodplains and wetlands as part of forest planning actions.
7.3	Protection of Wetlands	Avoid adverse water-quality impacts associated with destruction, disturbance, or modification of wetlands.	The Forest Service will not permit the implementation of activities and new construction in wetlands when there is a practical alternative. Factors relevant to the effect of the proposal on the survival and quality of the wetlands will be considered when evaluating proposed actions in wetlands. Factors to be evaluated include, but are not limited to, water supply, water quality, recharge areas, functioning of the wetland during flood and storm events, flora and fauna, habitat diversity and stability, and hydrologic function of riparian areas.	Ensure that wetland values are considered and documented as an integral part of all planning processes. Determine whether proposed actions will be located in wetlands and, if so, whether there is a viable alternative. Replacement in kind of lost wetlands should be evaluated to apply a "no net loss" perspective to wetland preservation. During project planning establish communications with other agencies legislatively responsible for protecting wetlands, Corps of Engineers and EPA at the minimum, to ensure that local requirements are identified and incorporated into the project plan. Ensure that all mitigating measures are incorporated into project plans and designs, and that the actions maintain the hydrologic and biologic function of the wetlands. All potentially impacted wetlands will be identified on maps as part of project development. Identification and mapping of wetlands will be a part of the LRMP data inventory process.
7.4	Forest and Hazardous Substance Spill Prevention Control and Counter-measure Plan	Prevent contamination of waters from accidental spills.	This is a preventive and corrective practice. The forest substance spill prevention control and countermeasure (SPCC) plan is a document designed to guide the emergency response to spills, or discovery of hazardous materials (HazMat) within the boundaries of each national forest. Spills are defined as either an intentional or accidental release, known or unknown substance; or the incidental discovery of a known or unknown substance. Each forest SPCC Plan must be compatible with appropriate county SPCC Plans that also guide	Each Forest Supervisor will be responsible for designating emergency spill response coordinators and documenting names with telephone numbers of agencies to call regarding response to emergency incidents. Individual forests should maintain an inventory of materials to use during the emergency response phase of HazMat within their capability. Disposal methods and sites must be coordinated with EPA, State, and local officials responsible for safe disposal.

BM P #	Title	Objective	Summary Explanation	Implementation
			emergency responses to spills and discoveries of HazMat. Forest SPCC Plans are prepared according to references and county SPCC Plans are prepared according to State guidelines. The composite of forest and county SPCC Plans provide a process to coordinate the various local, State and Federal agencies that have emergency response capabilities, into a unified force that can effectively react to actual or threatened releases or HazMat within the forest boundary. Factors considered for each spill include, but are not limited to, the specific substance spilled, the quantity, its toxicity, proximity of the spill to waters, and the hazard to life and property. An SPCC Plan must be prepared if the total oil products on site in above-ground storage exceed 1,320 gallons, or if a single container exceeds a capacity of 660 gallons. Other HazMat (pesticides, raw sewage, road oils) also have specific criteria that determine when a SPCC Plan must be prepared and implemented.	All forests will maintain a SPCC plan, which meets the criteria of the referenced directives in Section 13, and require appropriate special use permittees, timber sale operators, other contractors, and forest users to develop companion SPCC Plans before operating within the national forest boundary. Forest SPCC Plans and forest users' SPCC Plans must be approved by the Forest Supervisor. Timber sale SPCC Plans must be approved by a licensed professional engineer.
7.5	Control of Activities Under Special Use Permit	Protect surface and subsurface water quality from physical, chemical, and biological pollutants resulting from activities that are under special use permit.	Some activities and uses by others take place on NFS lands, which are not directly related to Forest Service management activities (for example, electronic sites; highway, road, and railroad rights-of-way; waste water treatment and disposal; and power transmission lines). There are also uses by others on NFS land, which are related to NFS management activities. (Examples of these types of uses are organization camps, recreation residence tracts, and ski areas.) Both the related and non-related uses of NFS lands by others are administered through permits issued by the Forest Service to public or private agencies, a group, or an individual.	The Forest Service official responsible for permit issuance and administration will include in the special use permit under which the permittee must operate, details of the conditions that must be met including management requirements and mitigation measures necessary to protect water quality. The permittee will be required to conform to all applicable State and local regulations governing water quality and sanitation. State water quality law may require that the permittee obtain a waste discharge requirement from a RWQCB. Failure on the part of the permittee to meet the conditions of the special use permit may

BMP #	Title	Objective	Summary Explanation	Implementation
			Activities on lands withdrawn under authority of the Federal Energy Regulatory Commission (FERC) will be exempt from Forest Service administrative control through the NFS permit system. When a FERC permit is issued, or renewed, the Forest Service makes a complete study of water quality and quantity needs, and provides FERC with recommended requirements and mitigation measures under which the permittee should operate to protect natural resources.	result in the permit being revoked.
7.6	Water Quality Monitoring	Collect representative water data to determine base line conditions for comparison to established water-quality standards that are related to beneficial uses for that particular watershed.	Water quality monitoring is a mechanism which evaluates the implementation and effectiveness of a management prescription in protecting water quality (beneficial uses identified in the environmental analysis.) A water quality monitoring plan will be part of an environmental document, a management plan, or a special use permit, or it will be developed in response to other needs. Implementation: A water	A water quality monitoring plan will be written, or reviewed by a hydrologist and will be implemented by the hydrologist, or by other qualified forest personnel. The actual analysis of the data will be performed by the hydrologist, State-certified laboratory, or other trained forest personnel, or combinations of these as appropriate. (See also BMP 4.2 and BMP 4.3.) Interpretation of the data and any reporting will be accomplished by the hydrologist, or trained personnel. The EPA STORET system will be used for computer storage of all data collected.
7.7	Management by Closure to Use (Seasonal, Temporary, and Permanent)	Exclude activities that could result in damages to either resources or improvements, such as roads and trails, resulting in impaired water quality.	A watershed may be in such a sensitive condition that any use during a given portion of the year, usually the rainy season, could result in soil and/or land stability problems and associated adverse effects to water quality. In other cases, water quality may already be impaired, and improvement may not be considered practical without substantially reducing or eliminating further use. These conditions could have resulted from past land use or natural disasters. Closure to use will be used when the condition of the watershed must be protected to preclude adverse water-quality effects.	Closures will be made when the Forest Supervisor, District Ranger, or Forest Service officer responsible for resource protection determines that a particular resource or improvement needs protection from use. An interdisciplinary team or resource specialist normally recommends closure. The decision will be made to close an area after an evaluation of alternative methods of protection dictates that closure is a required action. This is usually a last-step protective measure.

BMP #	Title	Objective	Summary Explanation	Implementation
			(See also BMP 1.5 and BMP 2.9.)	
7.8	Cumulative Off-site Watershed Effects	Protect the identified beneficial uses of water from the combined effects of multiple management activities which individually may not create unacceptable effects, but collectively may result in degraded water-quality conditions.	Cumulative off-site watershed effects (CWE) include all effects on beneficial uses that occur away from the sites of actual land use activities and which are transmitted through the drainage system. Effects can be either beneficial or adverse and result from the synergistic or additive effects of multiple management activities within a watershed. Professional judgment is used to evaluate CWE susceptibility, on a watershed basis, as part of the decision-making process. These assessments are made using known information about beneficial uses, climate, watershed characteristics, land use history, and present and reasonably foreseeable future land use activities. Initial evaluation of CWE susceptibility is based on what is known about the study watershed and other watersheds with similar physical and climatic characteristics. Comparison of land-disturbance history and resulting impacts to beneficial uses in these watersheds results in an estimate of the upper limit of watershed tolerance to land disturbance.	CWE susceptibility evaluations and development of mitigative measures are accomplished through the environmental documentation process, using an interdisciplinary approach, guided by the Regional methodology. Forests having similar climatic, watershed, and land-use characteristics will work together to refine CWE assessments to be responsive to local conditions. Each forest will monitor to determine the effectiveness of CWE analysis in reducing the risk of adverse effects and obtaining desired results from mitigation measures and management requirements. Monitoring results will also be used to refine the analysis and, where necessary, modify the analysis process.

Table 9. Range Management (12.81) Best Hydrologic Management Practices (BMPs) – *Summary of R5 FSH 2509.22 - SOIL AND WATER CONSERVATION HANDBOOK, CHAPTER 10 - WATER QUALITY MANAGEMENT HANDBOOK; Amendment No.: 2509.22-2011-1;* ***Effective Date:*** *December 5, 2011*

BMP #	Title	Objective	Summary Explanation	Implementation
8.1	Rangeland Management Planning	Use the allotment management planning process to develop measures to avoid, minimize, mitigate and/or restore adverse impacts to water and aquatic and riparian resources during rangeland management activities.	Analysis of existing rangeland conditions and other resource values is conducted for each allotment in the development of an AMP. The AMP is the primary document that guides implementation of forest plan direction for rangeland resources at the allotment (project) level. It is included as part of the grazing permit and provides special management provisions, instructions, and terms and conditions for that permit. The risk from livestock grazing can be managed in the planning process by using the appropriate techniques from the Implementation list in the adjacent column adapted as needed to local site conditions.	Determine potential grazing suitability. Determine rangeland condition as part of rangeland analysis and planning process. Assess the current functionality in relation to compliance with water-quality objectives and protection of the beneficial uses of water of rangeland and riparian areas using proper functioning condition protocols. Identify sites at risk of degradation using proper functioning condition protocols. Assess long-term trends of rangeland sites within riparian allotments using accepted protocols (the rooted frequency protocol). Establish desired conditions for rangelands that consider linkages to riparian and aquatic systems. Establish desired conditions for riparian and aquatic systems that reflect their ecological potential. Review past management within the allotment. Identify potential management strategies. Identify improvement needs. Include management objectives for livestock grazing and all

BMP #	Title	Objective	Summary Explanation	Implementation
				resources including compliance with water-quality objectives and protection of the beneficial uses of water affected by livestock grazing in AMP, Grazing Permit and Annual Operating Instructions (AOI). The objectives are derived from management direction in the forest plan, biological opinions, or other binding direction. Establish management requirements such as the season of use; number, kind, class of livestock; and the grazing system to be used in the AMP. Management requirements should maintain or move resources in the allotment toward desired conditions. Establish annual endpoint indicators of use related to the desired conditions and triggers (thresholds) for management actions, including modification of livestock intensity; frequency, duration and timing of livestock use (better distribution of stock); change in animal months and/or season of use; and livestock exclusion. Set the indicator thresholds at levels that protect or improve condition of riparian areas and aquatic ecosystems. Include schedules in the AMP for: **(1)** rehabilitating rangelands that do not meet forest plan objectives; **(2)** initiating range improvements; and **(3)** maintaining existing improvements (see BMP 8.3). Include monitoring requirements in the allotment management plan to evaluate: **(1)** compliance with triggers and annual endpoint indicators of use (for example, utilization, stubble height, stream alteration) and other forest plan standards as appropriate; and **(2)** indicators of management effectiveness, such as greenline vegetation

BMP #	Title	Objective	Summary Explanation	Implementation
				stability, bank stability, greenline-to-greenline width, and shrub height.
8.2	Rangeland Permit Administra-tion	Manage rangeland vegetation and grazing to protect water and aquatic and riparian resources through administration and monitoring of grazing permits and annual operating instructions.	Improper grazing can adversely affect watershed condition in several ways. Loss of effective ground cover in the uplands leads to increases in overland flow and peak runoff. Soil compaction and loss of ground cover and plant vigor in riparian areas decrease the ability of the riparian area to filter pollutants and function as a floodplain. Streambank trampling increases stream channel width/depth ratio, resulting in a change in stream type and a lowering of the water table. Wider and shallower streams have higher stream temperatures and lower dissolved oxygen content. Introduction of sediment, nutrients, and pathogens from grazing can lower water quality. The potential for these impacts can be limited by managing livestock numbers, distribution, timing and season of use. A temporary or term grazing permit authorizes livestock grazing on NFS lands. The permit delineates the area to be grazed and defines the number, kind, and class of livestock to be grazed, and the season of use. The permit includes both general and special terms and conditions. Required management practices are included under the special terms and conditions. These practices contain standards designed to protect water quality and other resource values. Standards included in the permit may be derived from	**Monitoring--** **1.** Make field checks and measurements at least annually as described below (by Forest Service or permittee with quality control provided by the Forest Service). **2.** Emphasize monitoring that determines permittee compliance with permit provisions. **3.** Include indicators of annual use that relate to water quality, riparian and aquatic ecosystem protection in compliance monitoring, such as forage utilization, streambank alteration, or utilization of woody riparian vegetation. **4.** Use monitoring results as an adaptive management feedback loop to revise the AOIs to account for current allotment conditions and trends. Figure 2 illustrates the adaptive management process used in managing range allotments. **5.** Monitor indicators of management effectiveness and trends that affect water quality, as well as habitat or other beneficial uses as necessary (for example, 303.listed streams and terms of biological opinions). **Livestock Number and Distribution—** **1.** Use results of annual compliance monitoring and periodic trend monitoring, as well as forage utilization by wildlife, to determine allowable annual amount of livestock use to meet rangeland desired conditions. **2.** Document allowable use, the planned sequence of grazing on the allotment, and any other operational changes in the AOIs issued to the permittee each year. **3.** Alter livestock distribution when monitoring and periodic assessments indicate consistent non-compliance with permit provisions.

BM P #	Title	Objective	Summary Explanation	Implementation
			the forest plan, applicable biological opinions, or site-specific measures developed during range analysis. The permit also includes the location and type of monitoring to be conducted to assess compliance with standards, and determine trend in range condition. When an AMP is in place, AOIs are issued to the grazing permit permittee. The instructions specify those annual actions needed to implement the management direction set forth in the project-level NEPA-based decision. Actions in the instructions must be within the scope of the project-level decision, and as such, are not required to undergo any additional site-specific environmental analysis. The AOIs identify the obligations of the permittee and the Forest Service, and clearly articulate annual grazing management requirements, standards, and monitoring necessary to document compliance. The Forest Supervisor or District Ranger will approve grazing permits and annual operating instructions; the permittee carries out the terms and conditions of the permit under the immediate direction and supervision of the District Ranger. The risk from livestock grazing can be managed by using the appropriate techniques from the list in the column to the right adapted as needed to local site conditions.	**4**. Manage livestock use through control of time/timing, intensity, and duration/frequency of use in riparian areas and wetlands to maintain or improve long-term functional stream condition, and allow for riparian hardwood growth extension and/or other stabilizers (herbaceous plants) and reproduction where the riparian plant community is below its desired condition and livestock are a key contributing factor. **5**. Manage livestock to prevent further degradation of riparian areas and wetlands that are not meeting or moving toward desired condition objectives. **6**. Exclude livestock if monitoring information shows continued livestock grazing would prevent attainment of those objectives. **7**. Locate stock tanks, salt supplements, and similar features to distribute cattle evenly over the allotment and prevent concentrations of cattle in SMZs and wetlands. **8**. Keep stock driveways out of riparian areas except to cross at designated points. **9**. Establish triggers for livestock trampling and riparian vegetation utilization on or immediately adjacent to stream banks for timing livestock moves between units. **10**. Manage livestock herds to avoid concentrating in riparian areas and wetlands during the hot season (mid-to-late summer). **Season of Use**-- **1**. Adjust livestock numbers and/or season of use when monitoring and periodic assessments show consistent non-compliance with permit provisions. **2**. Manage to avoid livestock grazing through an entire growing season in pastures that contain riparian areas and wetlands. **3**. Apply short-duration grazing as practicable (generally

BMP #	Title	Objective	Summary Explanation	Implementation
				less than 20 days) to minimize re-grazing of individual plants, to provide greater opportunity for regrowth, and to manage utilization of woody species and reduce soil compaction. **Permit Administration--** **1.** Use permit authorities to change operations to protect water and aquatic and riparian resources when special circumstances (such as drought) occur. **2.** Take corrective actions if monitoring and periodic assessments show consistent non-compliance with permit provisions. Actions might include: **(a)** adjusting livestock numbers and/or season of use **(b)** altering livestock distribution **(c)** installing fences and water developments. An **(d)** rest, placing the allotment (or unit of concern) in non-use status for a period of time that allows for natural recovery of resource condition where potential exists. **3.** Apply suspension and cancellation guidelines in cases of intentional noncompliance with the terms and conditions of the permit. **4.** Modify, cancel or suspend the permit in whole or in part as needed where it has been determined to be necessary to ensure proper use of the rangeland resource and protection of other resources, such as water quality.
8.3	Rangeland Improve-ments	Implement range improvements to protect, maintain or improve water and aquatic and riparian resources and associated beneficial uses.	Rangeland improvements targeted at water and aquatic and riparian resources are designed to protect or improve conditions of sensitive areas such as streams, riparian areas, and wetlands or upland areas in danger of crossing a threshold to a less desirable condition and move these resources toward desired conditions. Improvements should emphasize protecting the beneficial uses in	**1.** Identify range improvement needs during watershed analysis, watershed condition assessment, AMPs, or other assessment efforts. **2.** Evaluate improvement needs in the AMP. **3.** Include and schedule improvement actions as appropriate in the AMP and grazing permit.

BM P #	Title	Objective	Summary Explanation	Implementation
			these areas. Improvements may supplement administrative actions such as rest or changes in annual use levels, seasonal use, distribution, and number. Either the permittee or the Forest Service can be responsible for developing and maintaining rangeland. The District Ranger will ensure that the permittee is involved as a cooperator in rangeland improvements. And, as appropriate, the permittee may participate in the construction and/or maintenance of improvements under Forest Service direction. Implementation may also be done by Forest Service crews, or contractors. Use the appropriate techniques from the list in the column to the right, adapted as needed to local site conditions to implement rangeland improvements.	**4**. Design improvements to sustain forage production for livestock and provide protection to the other resources. **5**. Consider the following when evaluating need for improvements: a. Fencing **b**. Soil and stream rehabilitation **c**. Off-site water development **d**. Seeding and planting

Table 10. Road Management (12.21) Best Hydrologic Management Practices (BMPs), Including OHV BMPs from Recreation Chapter 12.41– ***Summary of R5 FSH 2509.22 - SOIL AND WATER CONSERVATION HANDBOOK, CHAPTER 10 - WATER QUALITY MANAGEMENT HANDBOOK; Amendment No.: 2509.22-2011-1; Effective Date:*** *December 5, 2011*

BMP #	Title	Objective	Summary Explanation	Implementation
2.1	Travel Management Planning and Analysis	Roads impact water quality to varying degrees. Use the travel analysis and road management planning processes to develop measures to avoid, minimize, and mitigate adverse impacts to water, aquatic, and riparian resources during road management activities, contribute toward restoration of water quality where needed, and identify the road system which can be effectively maintained.	The Forest Service is currently engaged in a nationwide effort to identify the minimum road networks needed on national forests for resource management and visitor access. This effort is being implemented under the Travel Management Rule subpart A (36 CFR, part 212). Roads on NFS lands are assessed through the travel management process both in terms of the benefits provided and the risks to natural resources, including water quality. Various planning processes are involved in determining the number, type, and location of roads. Road management-related planning includes travel analyses, as well as consideration of road management in projects. Planning occurs at scales that range from forestwide assessments and plans, to watershed-scale or project-level analyses, to individual road activities. Effects to the water, aquatic, and riparian resources are assessed during planning and balanced with the social, economic, and land-management needs of the area. Appropriate protection and mitigation measures are considered when water, aquatic, and riparian resources are anticipated to be adversely impacted, or are already impaired. Project-level travel analysis is conducted to inform decisions and facilitate vegetation,	**1.** Apply techniques of BMP 2.1(Travel Management Planning and Analysis) as applicable. **2.** Conduct Travel Analysis (see description of the Travel Management Rule Subpart A above under Explanation) to determine the minimum road system needed for safe and efficient travel, administration, utilization, and protection of forest land and water resources. Identify current and future needs and uses of each NFS system and unauthorized road. **3.** Identify road segments causing or threatening to cause adverse impacts to environmental resources (that is, soils, water, aquatic or riparian habitat), utilizing refinement of modeling commensurate with the scale of travel analysis being performed. **a.** Use physically based, empirical, or conceptual road erosion and delivery models based on field-based road inventory data to identify the relative impact or risk of adverse impacts to water resources. **b.** Identify relative risk of crossing failure by assessing: **(1)** Hydraulic capacity of crossing **(2)** Signs of plugging or aggradation at the culvert inlet **(3)** Condition of drainage structure (for example, a culvert) **(4)** Potential for drainage diversion **c.** Identify relative risk of road-induced mass wasting. **d.** Update road information periodically to adequately reflect time-varying road conditions (that is, road condition after high-magnitude, low-frequency storm events). **4.** Locate, correctly interpret, and use readily available and relevant scientific literature and field data in the analysis. Disclose any assumptions made during the analysis, and

BMP #	Title	Objective	Summary Explanation	Implementation
			fuels, range, recreation, or other management actions. Such analysis contains detail on the condition of individual roads within the project area, as well as the impacts by the roads. Specific actions for protection, and improvement of water quality, if needed, are identified for implementation as funding for a project becomes available. Options for road management include maintaining, improving, relocating, converting to other use, placement into storage, and decommissioning. Road management objectives document the intent and purpose of each route providing access in support of the forest's LRMP. In addition, road management objectives document maintenance objectives, environmental concerns, and management constraints.	reveal the limitations of the information on which the analysis is based. Use and/or collect data in accordance with FSH 7709.55 chapter 20, to identify the relative impact or risk of adverse impacts to water resources. **5.** Identify and rank relative risk of crossing failure. **6.** Identify and prioritize mitigation measures for existing roads that cause resource or watershed impacts. Mitigation measures may include any of the following: **a.** Relocating road segments that adversely impact soil or water resources. **b.** Reconstructing road segments to modify, improve, or restore road drainage. **c.** Improving roads with deferred maintenance needs to current standards. **d.** Improving stream crossings to accommodate bedload and debris, and provide for aquatic habitat and passage. **f.** Hardening road surfaces (that is, running surface or inside ditches) to prevent the generation of fine-grained surface material and/or armor portions of the road prism subject to concentrated runoff. **g.** Putting roads in storage, while maintaining hydrologic and geomorphic functionality of drainage features (see BMP 2.6 - Road Storage). **h.** Closing roads seasonally to protect water resources. **i.** Restoring surface and subsurface hydrologic properties by removing roads from sensitive environments including riparian areas and meadows. May include relocation or decommissioning. **j.** Permanently closing roads that cause significant adverse impacts to soil or water resources. **k.** Decommissioning or converting unnecessary roads to other uses, such as trails (see BMP 2.7 - Decommissioning). Assess risk of impact to water quality by decommissioning, placing road in storage, or converting to other use, and

BMP #	Title	Objective	Summary Explanation	Implementation
				various treatments for each option. **7.** Review road management objectives for on-site changes to originally recorded documents. **a.** Identify current type of vehicle use and volume. **b.** Monitor for effectiveness of design features on water quality, aquatic, and riparian resources. **c.** Identify appropriate access management strategy (that is, encourage use, accept use, discourage use, eliminate use, and prohibit use (FSM 7731.11)) for each road. **d.** Incorporate changes from original road management objectives into analysis, and if necessary, update objectives. **e.** Propose mitigations where needed and prioritize **8.** Avoid keeping roads that display risks to water quality that outweigh benefits, when possible. Define mitigation measures for existing roads that impact water quality. **9.** Plan new NFS roads only when needed to support the forest LRMP. **10.** Inventory and analyze unauthorized roads. Based on benefits and risks, identify roads for future inclusion in the forest's transportation system, conversion to another use, or decommissioning. **11.** At project-level analysis, roads identified for one-time use only are temporary roads, subject to decommissioning according to the Forest and Rangeland Renewable Resources Planning Act (16 USC 1608).
2.2	General Guidelines for Location and Design of Roads	Locate roads to minimize problems and risks to water; aquatic, and riparian resources. Incorporate measures that prevent or reduce impacts, through design for construction, reconstruction, and other	A road's location and design may have long-term effects on water quality, construction and maintenance costs, safety, and other public resources. Road location and design control hydrologic connectivity—the degree that road runoff and sediment are linked to the stream channel network. The extent of hydrologic connectivity, along with the magnitude and frequency of road erosion,	**Location:** **1.** Avoid locating new roads where water-quality risks outweigh beneficial uses. **2.** Locate roads to fit the terrain, limit the need for excavation, and prevent damage to improvements and resources. **3.** Avoid sensitive areas such as riparian areas, wetlands, meadows, bogs, fens, inner gorges, overly steep slopes, and unstable landforms to the extent practicable. If such areas

BM P #	Title	Objective	Summary Explanation	Implementation
		route system improvements.	drives road-related water-quality impacts. Roads are located according to standards and specifications to meet their use objectives, while protecting other resources. Well-defined project objectives are necessary to locate and design roads that will best address environmental and resources issues, as well as safety and traffic requirements. Designs of new roads and upgrades to existing roads consider ways to reduce impacts to beneficial uses of water. Management needs have changed considerably since most NFS roads were constructed. Influences of roads on aquatic and riparian resources are recognized and considered. Road maintenance budgets and opportunities have diminished. Designs for improvements to existing roads significantly reduce or eliminate impacts to beneficial uses of water. Drainage features and surfacing are among elements often considered for change. Improvements to the road system are made on a priority basis that considers road and resource condition, beneficial uses at risk, and cost. In addition, some situations may require adherence to special conditions associated with Clean Water Act permits for water quality certification (401), stormwater (402), and discharge of dredge and fill material (404). State and local entities may also provide guidance and regulations such as a	cannot be avoided: **a.** Use bridges or raised prisms with diffuse drainage to sustain flow patterns **b.** Set crossing bottoms at natural levels of channel beds and wet meadow surfaces **c.** Avoid actions that may dewater or reduce water budgets in wetlands. Consider compensatory mitigation or mitigation banking. **4.** Locate roads outside SMZs whenever possible, with a minimum of number of crossings and connections between the road and streams. **5.** Relocate existing routes or segments that are in high-risk locations, including the SMZ, to the extent practicable. **6.** Relocate roads that are causing uncontrollable adverse effects to beneficial uses of water, with commensurate decommissioning of high-risk roads. **7.** Consider potential for generation of waste material in location of roads, and need for access to appropriate disposal areas. Waste or spoil may not be placed within SMZs, on slopes greater than 60 percent, on unstable slopes, or in areas subject to converging runoff. **8.** Locate roads in an interdisciplinary manner with a hydrologist, soils scientist, and geologist, if necessary. **9.** Final road location drives design features, assuring protection of water quality. Incorporate modeling as necessary to assist with design of road segments displaying higher erosion potential. **Design:** **1.** Design roads to balance cuts and fills or use full bench construction where stable fill construction is not possible. **a.** Consider full bench construction or mechanically stabilized fills on unstable slopes or slopes greater than 60 percent.

BMP #	Title	Objective	Summary Explanation	Implementation
			Forest Practices Act or a Stream Alteration Act. Forest plans often contain direction on location of roads relative to streams, wetlands, and unstable landforms. The risk from road management activities can be managed by using the appropriate techniques for road location and design from the list in the column to the right, and adapted as needed to local site conditions.	**b.** Ensure design addresses method to stabilize constructed fill slopes, including key ways where fill slopes exceed 3 feet in height at the hinge point. **c.** Do not design to discharge runoff on to unstable landforms, such as hollows. **2.** Design road surfaces to dissipate intercepted water in a uniform manner along the road by outsloping, insloping with drains, or crowning with drains, subject to site soil characteristics to prevent the discharge of sediment to surface waters. **3.** Design to reduce the hydrologic connectivity of the road segment or network. **4.** Limit occurrence of connectivity areas to water crossings only, if possible. **5.** Choose low-maintenance designs (for example, outsloping and rolling the grade) for roads that may be subject to minimal use or will be put in storage. **6.** Follow general principles of stormwater and erosion control related to roads including permanent and temporary controls that: **a.** Minimize soil compaction (except as needed to achieve compaction standards on road prism) and bare ground coverage. **b.** Separate exposed bare ground from surface waters. Incorporate vegetation or slash over exposed fill slopes. **c.** Design stable road prisms and stream crossings. **d.** Use geotextiles when necessary to avoid mixing aggregate with subgrade and subsequent rutting of road. **7.** Employ treatments that control stormwater and erosion at the source through the use of small-scale treatments distributed throughout the road prism. **8.** Design properly spaced cross drains to provide maximum filter distance and to limit hydrologic connectivity between the road and water resource where practicable.

BM P #	Title	Objective	Summary Explanation	Implementation
				9. Design subsurface dispersion measures and cross drains as necessary to capture and disperse expected flows contributed by locally shallow groundwater and road surfaces. **10.** Design energy dissipaters, apron, downspouts, gabions, flumes, oversize drains and debris racks, culvert and cross drain inlets and outlets, where needed to prevent erosion and discharge of sediment to surface waters. Do not discharge runoff on to unstable surfaces. **11.** Design stable ditch configuration that does not erode, yet does not fail during mechanical maintenance activity **12.** Carefully consider impacts vs. benefits of berm in the control of runoff. Avoid berms except where needed to facilitate drainage patterns without adverse impact to water quality. **13.** Design spot surface treatments to areas that are sensitive, erodible, subject to high seasonal water tables, or will be heavily traveled. **14.** For roads located within the SMZ where adequate buffer zone does not exist, design for aggregate or paved surface. Design for a floodplain surface to slow water velocities and minimize erosion by flood flows (energy dissipation). **15.** Generally use the minimum road standards for grade and alignment (width, turning radius, maximum slope) to accommodate the design vehicle and traffic mix and volume. **16.** Consider maintenance requirements in road design. **17.** For roads to be reconstructed, incorporate design features to reduce or eliminate identified water-quality impacts. **Crossings:** **1.** Design both temporary and system roads to limit the number of surface-water crossings necessary to meet

BMP #	Title	Objective	Summary Explanation	Implementation
				planned activity objectives and safety requirements. **2.** When necessary to cross streams, find optimal places for road-stream crossings. If possible avoid: **a.** Areas requiring steep road approaches. **b.** Crossing braided or migrating stream channels. **c.** Flat stream gradient immediately downstream of steep stream gradients. **d.** Areas requiring deep fills. **e.** Areas immediately downstream of unstable slopes or landforms. **3.** Design crossing approaches so road surfaces and drainage features have minimum hydrologic connectivity with channels. **4.** Design diversion potential dips at existing crossings where there is a risk of flow diversion or where crossing fills are higher than approaches. Consider hardened fills commensurate with fill height. Consult with hydrologist. **5.** Design stream-crossing structures to provide the most resource protection consistent with facility needs, legal obligations, and cost considerations. **6.** Provide for desired passage of aquatic and terrestrial organisms, debris, and bedload as well as flow. **a.** Size crossings for the 100-year flood event, plus associated debris and sediment, or greater. **b.** Design for stream simulation if feasible in consultation with hydrologists and fisheries biologists. **7.** Consider using culvert arrays, perched culverts and/or permeable fills in meadow environments or areas with naturally high water tables to encourage meadow function.
2.3	Road Construction and Reconstruc-tion	Minimize erosion and sediment delivery from roads during road construction or reconstruction, and their	During road construction and reconstruction activities, vegetation and ground cover are removed, often exposing both the surface and subsurface soil to erosion. Temporary and long-term erosion-control measures are	Enforcement of the techniques is the responsibility of the inspector and contracting officer's representative for public works contracts, the inspector and engineering representative for timber sale roads, and the permit administrator for roads constructed or reconstructed under

BMP #	Title	Objective	Summary Explanation	Implementation
		related activities.	necessary to reduce erosion and maintain overall slope stability. These erosion-control measures may include vegetative and structural techniques to ensure the area's long-term stability. The risk from road construction and reconstruction activities can be managed by using the appropriate techniques from the following list adapted as needed to local site conditions.	administrative operations (that is, Road Use Permit, Special Use Permit, and so forth). If roads are constructed or reconstructed by force account crews, the project manager and foreman are responsible for adherence to project drawings, specifications, and erosion control plan. 1. Implement the approved erosion control plan that covers all disturbed areas, including borrow areas and stockpiles used during road management activities (see BMP 2.13-Erosion Control Plan). Include the forest's wet weather operations standards (WWOS). **2.** Maintain erosion-control measures to function effectively throughout the project area during road construction and reconstruction, and in accordance with the approved erosion control plan (see BMP 2.13- Erosion Control Plan). **3.** Set the minimum construction limits needed for the project and confine disturbance to that area. **4.** Locate and designate waste areas before operations begin. **a.** Deposit and stabilize excess and unsuitable materials only is designated sites. **b.** Do not place such materials on slopes with a high risk of mass failure, in areas subject to overland flow (for example, convergent areas subject to saturation overland flow), or within the SMZ. **c.** Provide adequate surface drainage and erosion protection at disposal sites. d. Comply with BMP 2.5 - Water Source Development and Utilization. 5. Comply with BMP 2.11 - Equipment Refueling and Servicing. **6.** Do not permit sidecasting within the SMZ. Prevent excavated materials from entering water ways or SMZs. **7.** Develop and follow blasting plans to move materials when necessary. **a.** To the extent possible, restrict blasting in sensitive

BMP #	Title	Objective	Summary Explanation	Implementation
				areas and those sites with high landslide potential. **b.** Restrict blasting after intense storms when soils are saturated. **c.** Prevent damage from fly rock and overshot by not overloading shots, installing blasting mats, or avoiding setting charges through variable rock strata. **8.** Schedule operations when rain, runoff, wet soils, snowmelt or frost melt are less likely. Follow seasonal restrictions of the forest's WWOS, and notification protocols, as outlined in an approved erosion control plan. **a.** Optimally, schedule construction during dry periods, while still adhering to other seasonal restrictions (wildlife breeding, spawning, fire activity levels, and so forth), consistent with local ordinances. **b.** Stabilize project area during normal operating season when the National Weather Service predicts a 30 percent or greater chance of precipitation, such as localized thunderstorm or approaching frontal system. **c.** Keep erosion-control measures sufficiently effective during ground disturbance to allow rapid closure when weather conditions deteriorate. **d.** Complete all necessary stabilization measures prior to predicted precipitation that could result in surface runoff. **9.** To the extent possible, construct new stream crossings when streams are dry or when stream flow is at its lowest. Install sediment controls. **10.** Comply with BMP 2.8- Stream Crossings. **11.** Limit operation of equipment when ground conditions could result in excessive rutting, soil compaction (except on the road prism or other surface to be compacted), or runoff of sediments directly to streams. **12.** On slopes greater than 40 percent, the organic layer of the soil shall be removed prior to fill placement, according to project specifications.

BM P #	Title	Objective	Summary Explanation	Implementation
				13. Waste organic material, such as uprooted stumps, cull logs, accumulations of limbs and branches, and unmerchantable trees, shall not be buried in logging road or landing fills. Dispose of waste organic material according to project specifications, in locations designated for waste disposal. Assure compliance with the project erosion control plan. **14.** Construct fills and keyways according to design drawings and specifications, not exceeding specified lift thickness and moisture content. Ensure uncompacted materials are prevented from leaving disturbance limits. **15.** Stabilize all disturbed areas with mulch, erosion fabric, vegetation, rock, large organic materials, engineered structures, or other stabilization measures according to the Erosion Control Plan, and project specifications and drawings for permanent controls (that is, crib walls, gabions, riprap placement, and so forth). **16.** Scatter construction-generated slash on disturbed areas to help control erosion. **a.** Ensure ground contact between slash and disturbed slopes. **b.** Windrow slash at the base of fill slopes to reduce sedimentation. **c.** Ensure that windrows are placed along the contour and that there is ground contact between slash and disturbed slope. **17.** Remove large limbs and cull logs to designated sites outside the SMZ or relocate within the SMZ to meet aquatic resource management objectives. **18.** Monitor contractor's plans and operations to assure contractor does not open up more ground than can be substantially completed before expected winter shutdowns, unless erosion-control measures are implemented. **19.** If snow/rainy season operations are proposed,

BMP #	Title	Objective	Summary Explanation	Implementation
				specifications for snow/ice depth or soil operability conditions must be described. Include these specifications in the erosion control plan (see BMP 2.13- Erosion Control Plans). **20**. Install erosion-control measures on incomplete roads prior to precipitation events or the start of the winter period (November 16 through March 31) and in accordance with the approved erosion control plan: **a.** Remove ineffective temporary culverts, culvert plugs, diversion dams, or elevated stream crossings, leaving a channel at least as wide as before construction and as close to the original grade as possible. **b.** Install temporary culverts, side drains, cross drains, diversion ditches, energy dissipaters, dips, sediment basins, berms, dikes, debris racks, pipe risers, or other facilities needed to control erosion. **c.** Remove debris, obstructions, and spoil material from channels, floodplains, and riparian areas. **d.** Do not leave project areas for the winter with remedial measures incomplete. **e.** Plant vegetation, mulch, and amendments, or provide other protective cover for exposed soil surfaces. **21.** When pioneer roads are necessary: **a.** Confine construction of pioneer roads to the planned roadway limits unless otherwise specified or approved. **b.** Locate and construct pioneering roads to prevent undercutting of the designated final cut slope. **c.** Avoid deposition of materials outside the designated roadway limits. **d.** Dewater live streams where crossed by pioneer roads with appropriate diversion devices. **e.** Accommodate drainage with adequate temporary crossings.

BMP #	Title	Objective	Summary Explanation	Implementation
2.4	Road Maintenance & Operations	Ensure water-quality protection by providing adequate and appropriate maintenance and by controlling road use and operations.	Appropriate maintenance and control of road use and operations can protect water quality, aquatic and riparian resources, and capital investments. Maintenance needs and operational controls are informed by periodic inventory and assessment that determine road condition and the potential impacts the road has on water quality. Properly designed and maintained road surfaces and drainage systems can reduce adverse effects to water resources by facilitating natural hydrologic function. Roads and drainage systems normally deteriorate because of traffic, weather, and effects of maintenance. In addition, roads occasionally become saturated by new groundwater springs and seeps after a wildfire or unusually wet periods. Many such conditions can be corrected by timely maintenance. However, while routine maintenance may be needed to ensure the road performs as designed, it can also be a source of soil disturbance and therefore, sediment production. In particular, the grading of inside ditches and road surfaces can significantly increase sediment production rates. Less aggressive maintenance may be desired to minimize disturbance of stable sites. Road management objectives include the level and type of maintenance that a road is expected to receive. Assigned road	**Inspection:** **1.** Periodically inspect system travel routes to assess condition and linkage to water quality. This information assists in setting maintenance and improvement priorities. **a.** Provide training to the engineering personnel performing condition surveys to successfully identify and assess linkage to water quality. **b.** Conduct condition surveys jointly with engineering and hydrology personnel, to more accurately assess potential of road to impact water quality. **c.** Prioritize inspections to roads at high risk of failure, followed by road segments that are hydrologically connected to the stream network, to reduce risk of diversions and cascading failures. **d.** Identify diversion potential on roads, and prioritize for treatment. **2.** Inspect drainage structures and runoff patterns after major storm events and snowmelt, and perform any necessary maintenance. Major storm events include all storm events for which the National Weather Service issues a local flood watch, advisory, or warning. **a.** Determine the extent of hydrologic connectivity during and/or just after major storm events, including the connectivity of disturbed areas directly adjacent to the road network. Use this information to prioritize and plan improvements to road drainage. **b.** Immediately clean out, repair or reconstruct waterbars, inside ditches, culverts, and other features that are not functioning in order to hydrologically disconnect roads from surface waters and prevent discharges of sediment and other pollutants to water bodies. **3.** Regularly inspect roads during all operations. **4.** Keep roads closed to public use, but open for administrative use, in hydrologically functional condition. If

BMP #	Title	Objective	Summary Explanation	Implementation
			maintenance levels vary from 1 to 5, and are directly linked to the operational objectives for the road. Maintenance Level 1 is assigned to roads closed to all motorized vehicles for a year or more; they should be left in a stable condition, and by definition, require less maintenance. Maintenance Levels 4 and 5 are assigned to roads that are typically double-lane, aggregate-surfaced or paved, and passenger vehicle traffic is "encouraged." They are well maintained to provide a moderate to high degree of user comfort and convenience. Operational objectives and activities are also defined by the road management objectives, and depend upon the amount of maintenance a road is expected to receive. Road operations also include permit, contract, and agreement administration, control of seasonal use, sustaining roads in closed status and revising maintenance levels and seasonal closures, as needed. Road closures and restrictions are necessary because many forest roads are designed for dry-season use. Most local roads are not surfaced, while others have some surfacing or spot stabilization. Roads without stabilized surfaces or adequate base can be damaged by use during wet periods or by loads heavier than the road was designed to convey. Road maintenance plans are implemented through contract, cooperators, force account, and active timber sale or other authorized	waterbars are breached, forest personnel will promptly repair them. **5.** Encourage field personnel of all disciplines to observe road deterioration or damage commensurate with travel to field activities, and report to engineering, for immediate action, if necessary. **a.** Restrict operations if impact or imminent threat of impact to water quality is occurring. **b.** Consider restricting operations if road damage such as surface displacement or active rutting is occurring. **Maintenance Planning:** **1.** Incorporate the forest's Wet Weather Operations Standards and notification protocols in maintenance and operations. **2.** Develop and implement an erosion control plan commensurate with the complexity and scale, and duration of the activity. See BMP 2.13. **3.** Develop and implement annual maintenance plans that prioritize road maintenance work for the forest or district. **a.** Include roads identified as needing maintenance from field condition surveys, and roads identified through roads analysis and travel analysis that negatively impact water quality. **b.** Determine method of accomplishment (contract, force account, permit, and cooperative) and define responsibilities and maintenance timing in the plan. **4.** Planning for emergency interim/temporary erosion controls to protect water quality is considered for roads that may require immediate maintenance, but are beyond capability of annual maintenance plan. **5.** Identify roads with potential to improve water quality by modifying road prism and drainage patterns through maintenance operations.

BM P #	Title	Objective	Summary Explanation	Implementation
			activities. Contract, timber sale, and other authorized or permitted operations are bound by specifications and drawings. BMPs are incorporated as specifications, contract or sale clauses, operating plan requirements, permit clauses, and are often shown in the drawings. The contracting officer's representative is responsible for assuring compliance by contractors; engineering representative, TSA, or FSR assures compliance by cooperator, purchaser or permitted operator. Project manager and crew supervisor assures compliance for force account work. Optimally, the forest hydrologist works with the forest quality assurance personnel to determine if approved maintenance tasks are completed with minimal resource impacts. Adjustments to future maintenance plans and methods are considered when previous methods do not provide the needed protection to water quality. Risk from road maintenance activities can be managed by using the appropriate techniques from the list in the column to the right adapted as needed to local site conditions.	**a.** Analyze roads in an interdisciplinary manner to identify other impacts that may occur due to changes in road prism or drainage patterns. Consider local conditions and site characteristics. **b.** Implement diversion potential method per Forest Service Publication 9777.1814P-SDTDC Diversion Potential at Road-Stream Crossings. **c.** Consider user safety and protection of other forest resources. **d.** Provide training and reference materials for forest road managers, road maintenance operators, and road maintenance contract preparation personnel to work with hydrologists in identifying appropriate roads for revised maintenance procedures. **6.** Evaluate road management objectives when an inspection indicates road design is not meeting current transportation and/or resource needs. Road management objectives support forest LRMP prescriptions. **Maintenance Activities:** **1.** Maintain road surfaces to dissipate intercepted water in a uniform manner along the road by outsloping with rolling dips, insloping with drains, or crowning with drains. Where feasible and consistent with protecting public safety, utilize outsloping and rolling the grade (rolling dips) as the primary drainage technique. **2.** Adjust surface drainage structures to minimize hydrologic connectivity by: **a.** Discharging road runoff to areas of high infiltration and high surface roughness. **b.** Armoring drainage facility outlet as energy dissipater and to prevent gully initiation. **c.** Increasing the number drainage facilities with SMZs. **3.** Clean ditches and drainage structure inlets only as often

BM P #	Title	Objective	Summary Explanation	Implementation
				as needed to keep them functioning. Prevent unnecessary or excessive vegetation disturbance and removal on features such as swales, ditches, shoulders, and cut and fill slopes. **4.** Minimize diversion potential by installing diversion prevention dips that can accommodate overtopping runoff. Place diversion prevention dips downslope of crossing, rather than directly over the crossing fill, and in a location that minimizes fill loss in the event of overtopping. **a.** Place diversion prevention dips downslope of crossing, rather than directly over the crossing fill, and in a location that minimizes fill loss in the event of overtopping. **b.** Armor diversion prevention dips when the expected volume of fill loss is significant. **5.** Address risk and consequence of future failure at the site when repairing road failures. Use vegetation, rock, and other native materials to help stabilize failure zones. **6.** Maintain road surface drainage by removing berms, unless specifically designated otherwise. **7.** Install and preserve markers to identify and protect drainage structures that can be damaged during maintenance activities (that is, culverts, subdrains, and so forth) **8.** When grading roads or cleaning drainage structure inlets and ditches, avoid undercutting the toe of the cut slope. **9.** Grade road surfaces in accordance with road management objectives and assigned maintenance level. Grade only as needed to maintain a stable running surface and adequate surface drainage. **10.** Accompany grading of hydrologically connected road surfaces and inside ditches with erosion and sediment control installation. **11.** Identify additional road maintenance measures to protect and maintain water; aquatic, and riparian resources including: surfacing and resurfacing, outsloping, dips and cross drains, armoring of ditches, spot rocking, replacing

BM P #	Title	Objective	Summary Explanation	Implementation
				culverts, and installing new drainage features. **12**. Effectively maintain roads in storage to eliminate all motorized vehicle use. Maintain physical closure devices, if present, to be safe and effective. For roads where physical closure methods are not feasible, install signing to inform of road closure. **13**. Enforce pre-haul maintenance, maintenance during haul, and post haul maintenance (putting the road back in storage) specifications when maintenance level 1 roads are opened for use on commercial resource management projects. Require the commercial operator to leave roads in a satisfactory condition when project is completed. **14**. Opened for use on commercial resource management projects. Require the commercial operator to leave roads in a satisfactory condition when project is completed. **Operations:** **1.** Restrict or prohibit road use during periods when such use would likely damage the roadway surface or road drainage features are identified through Travel Analysis and Travel Management, and implement through enforcement of motor vehicle use map. Changes in road management are supported by appropriate analysis. Follow the forest's WWOS. See BMP 2.13. **2.** Require users to obtain permit(s) when proposed operations involve use of roads by vehicles larger than the design vehicle, or beyond typical operation period or season of use (that is, timber purchasers, mining operations, oversize vehicle movement, and so forth. Conditions of the permitted use may require: **a**. Strengthening the road surface by adding rock, dust palliatives, pavement, or armor, particularly in areas where surfaces are vulnerable to movement such as corners and steep sections.

BM P #	Title	Objective	Summary Explanation	Implementation
				b. Considering short-term road surface stabilization by dust abatement methods, such as watering. **c.** Upgrading drainage structures. **d.** Restricting use to low-ground-pressure vehicles or frozen ground conditions. **e.** Strengthening the road base if roads are tending to rut. **f.** Using a base course of rock and/or geotextile fabric to provide subsurface stability. **g.** Intensifying maintenance to handle the traffic without creating excessive erosion and damage to the road surface. **h.** Repairing damage to road and forest resources associated with use by permittee. **i.** Restoring the road to original standard of features, such as restoring waterbars. **3.** To the extent possible, ensure drainage features are fully capable of preventing pollutant discharges to surface waters before the start of the local winter season (such as November 16 to March 31) or before the start of runoff-inducing precipitation events. **4.** Permits to oversize or overweight loads require that damage by such loads be repaired by the permit holder. Damage includes impacts to water quality. **5.** Cooperative maintenance agreements follow Forest Service direction for use, maintenance, repairs, and responsibilities. **6.** Roads under easement are subject to terms of conditions for operation and maintenance
2.5	Water Source Development and Utilization	Supply water for road construction, maintenance, dust abatement, fire protection, and other management activities,	Water source development is needed to supply water for road construction and maintenance, dust control, and fire control. In-stream water drafting can substantially affect water flow and/or configuration of the bed, bank, or channel of streams. Aquatic	**Location and Development:** Critical to the effectiveness of this practice is the coordination of engineering representatives, hydrologists, fishery biologists, and permit and sale administrators. Locate existing developments, or proposed streams, and evaluate for feasibility of use; determine scope and scale of

BM P #	Title	Objective	Summary Explanation	Implementation
		while protecting and maintaining water quality.	species present could be at risk due to rapid changes or sustained reductions in flow, reduced dissolved oxygen, and/or increased water temperature. Exposed surfaces of water holes or other developments could erode and discharge sediment back into the waterway. In addition to direct hydrogeomorphic (forming and shaping landform by water) disruption to the channel and subsequent impacts to aquatic species, water-quality impacts can occur from road approaches that access the water drafting site. Many water drafting sites have steep approaches and in the absence of adequate drainage or surfacing, these approaches can become chronic sources of sediment and runoff to the channel. Water trucks often leak oil, and sometimes fuel, onto drafting pads, becoming a source of petroleum product contamination to surface waters. Regular monitoring of water supply developments, during construction and use, and enforcement of contract and sale clauses, specifications, and restrictions is the responsibility of inspectors, contracting officer representatives, engineering representatives, sale administrators, and force account crew foreman.	environmental risks; select techniques for mitigating disturbance to water quality; and compare with the economics of development and use: **1.** Water sources designed for permanent installation, such as piped diversions to off-site storage, are preferred over temporary, short-term-use developments. **2.** If off-site storage is not an option then the following locations shall be considered. **a.** Locations where flowing side channels rather than the main thread of the channel can be used for drafting. **b.** Areas with existing pools that can be partially blocked, rather than in-channel excavation are preferred. **c.** Sites where road approaches can be hydrologically disconnected from streams. **d.** Sites where the drafting pad can be placed above the bankfull elevation of the channel with little or no excavation and/or fill placement. **3.** Develop and implement Erosion Control Plan for water supply site construction and use. **4.** Follow the forest's wet weather operations standards and guidelines. See BMP 2.13. **5.** Excavation of streambed or bank materials for approaches, drafting pads, and water drafting intakes are subject to local or regional restrictions on ground-disturbing activities. **a.** Excavations should not occur during peak runoff season. **b.** Federally listed threatened and endangered species, sensitive (including State-listed) species, management Indicator species, and aquatic organisms of interest may impose further restrictions. **c.** Other restrictions such as spawning season may be applicable **6.** Basins shall not be constructed at culvert inlets for the

BM P #	Title	Objective	Summary Explanation	Implementation
				purpose of developing a waterhole, as these can exacerbate plugging of the culvert. **7**. Access approaches are located as close to perpendicular as possible to prevent stream bank excavation. **8**. Access approaches are stabilized with appropriate materials, depending on expected life and use frequency of the developed water source. **9**. Fish-bearing streams that are temporarily dammed to create a drafting pool shall provide fish passage for all life stages of fish. **10**. Temporary dams shall be removed when operations are complete. **11**. Removal shall be done gradually so that released impoundments do not discharge sediment into the streamflow. **12**. When diverting water from streams, bypass flows shall be maintained that ensure continuous surface flow in downstream reaches, and keep habitat in downstream reaches in good condition. **Drafting Operations:** **1**. For fish-bearing streams, the water drafting rate should not exceed 350 gallons per minute for streamflow greater than or equal to 4.0 cubic feet per second (cfs). **2**. Below 4.0 cfs, drafting rates should not exceed 20 percent of surface flows. **3**. Water drafting should cease when bypass surface flows drop below 1.5 cfs. **4**. For non-fish-bearing streams, the water drafting rate should not exceed 350 gallons per minute for stream flow greater than or equal to 2.0 cfs. **5.** Drafting rate should not exceed 50 percent of surface flow for non-fish-bearing streams. **6.** Water drafting should cease from non-fish-bearing

BM P #	Title	Objective	Summary Explanation	Implementation
				streams when bypass surface flow drops below 10 gallons per minute. **7**. Intakes, for trucks and tanks, shall be placed parallel to the flow of water and screened, with opening size consistent with the protection of aquatic species of interest. **8**. Drafting from gravity-fed storage tanks shall utilize the following **9.** Water storage tanks shall be fitted with properly sized pipes designed to cleanly return the tank overflow to the source stream. **10**. Outflow pipes shall be sized to fully contain the tank overflow and prevent it from overflowing onto the drafting pad or road surface. **11**. Water storage tank return pipes at the water outfall area shall be armored to prevent erosion of the streambed, bank, or channel. **12**. At the end of drafting operations, intake screens shall be removed and drafting pipes plugged, capped, or otherwise blocked or removed from the active channel to terminate water drafting during the winter season. **13.** Trucks directly drafting from the channel shall utilize the following practices. **14**. Water drafting by more than one truck shall not occur simultaneously. **<u>Approaches and Drafting Pads:</u>** **1.** Road approaches and drafting pads shall be treated to prevent sediment production and delivery to a watercourse or waterhole. **2.** Road approaches shall be armored as necessary from the end of the approach nearest a stream for a minimum of 50 feet, or to the nearest drainage structure (for example, waterbar or rolling dip) or point where road drainage does not drain toward the stream.

BMP #	Title	Objective	Summary Explanation	Implementation
				3. Areas subject to high flood events shall be armored to prevent erosion and sediment delivery to water courses. **4.** Where overflow runoff from water trucks or storage tanks may enter the stream, effective erosion control devices shall be installed (for example, gravel berms or waterbars). **5.** All water-drafting vehicles shall be checked daily and shall be repaired as necessary to prevent leaks of petroleum products from entering SMZs. **6.** Water-drafting vehicles shall contain petroleum-absorbent pads, which are placed under vehicles before drafting. **7.** Water-drafting vehicles shall contain petroleum spill kits. Dispose of absorbent pads according to the Hazardous Response Plan.
2.6	Road Storage	Ensure that roads placed in storage are maintained to so that drainage facilities and runoff patterns function properly, and damage to adjacent resources is prevented. Stored roads are managed to be returned to service, at various intervals.	Road maintenance needs on NFS lands typically exceed maintenance budgets. As a result, many low-standard, closed roads receive no maintenance and may go years without being inspected for maintenance needs. Plans for and design of such roads should reflect long intervals between maintenance activities, but provide protection to resources and investments. This approach reduces the risk of adverse impacts to water, aquatic, and riparian resources and reduces long-term maintenance costs. Road storage is not an alternative to road decommissioning (BMP 2.7). As described in BMP 2.1, each national forest will designate its minimum road network. Roads not included in the minimum road network will eventually be decommissioned. Only roads that are needed in the future will be considered for storage. A primary reason for putting roads into	**Implementation:** **1.** Roads that are placed in storage, but open as trails, motorized and non-motorized, will need to provide for the safety of the intended users. As such, pulling culverts may not be warranted. **2.** In an interdisciplinary manner, prepare and implement an erosion and sediment control plan for roads to be placed in storage. **3.** The forest watershed staff will work with the forest engineering staff to identify which culverts pose a threat to water quality and must be removed before a road is placed in storage. **4.** Road-stream crossings deemed safe to leave in stored roads will be treated to remove the potential for streamflow diversions in the event of a crossing failure or blockage, and will have rock armor added to downstream crossing fill where needed to prevent erosion. **5.** Existing crossings in low-risk situations where the culvert is sized appropriately, is stable, and does not impede aquatic passage remain in place. Prior to storing, ensure that the road, culvert, and all hydrologically connected drainage

BM P #	Title	Objective	Summary Explanation	Implementation
			Intermittent Stored Service is to reduce maintenance needs while limiting the risk of adverse effects to hydrologic function from stream crossing failures, fill failures, surface water routing, and modified drainage patterns. Roads placed in Intermittent Stored Service have the roadway retained to the extent practicable while meeting the` watershed objectives of reducing sediment delivery and restoring natural flow patterns. These are achieved by reducing sediment delivery from the road surface and fills, and reducing the risk of crossing failure and stream diversion. The risk from roads in Intermittent Stored Service condition can be managed by using the appropriate techniques from the following list adapted as needed to local site conditions. Project crew leaders and supervisors are responsible for ensuring that force account projects meet road closure procedures standards. Contracted projects are implemented by the contractor, or operator. Compliance with plans, specifications, and operating plans is ensured by the contracting officer's representative, engineering representative, or Forest Service representative. Permitted use of stored roads requires restoring the road to its previous stable condition after use by the permittee, as enforced by the permit administrator.	structures are cleaned, and sediment and erosion controls are intact and functioning. **6.** Only structures that have a long planned storage period and present a significant risk to stream channels are removed, due to increased disturbance and exposure. The removal of drainage structures is tied to the length of period of storage, as well as the ability to access structures that are not removed. **7.** The risk of increased sedimentation from ground disturbance and exposed surfaces associated with drainage structure removal is weighed carefully against the benefits of restoring long-term hydrologic functionality. **8.** Lay back the streambanks at the crossing-site at a width and angle that allows flows from infrequent events to pass without scouring or puddling. **9.** Armor the crossing-site, if needed to prevent scour and erosion. **10.** Maintain the same size and gradient at the crossing-site as the channel above and below the removed crossing-site. **11.** Angle the banks such that undercutting and slumping is not expected, and revegetation has a strong chance of success. **12.** Avoid concentrated flow in ditches by outsloping or using frequent waterbars or other means of cross draining the road. **13.** Outslope the road template where appropriate to disperse runoff, prevent concentrated flow, and avoid overly steep fills. **14.** Remove unstable material at unstable sites, seeps, slumps or where fills are failing. Place removed materials in stable locations where the stored material will not present a future risk to water, aquatic, or riparian resources. **15.** Depending on the extent of anticipated closure period, the following are performed in direct proportion to that time

BMP #	Title	Objective	Summary Explanation	Implementation
				period: **a.** Scarify or de-compact the road surface to promote vegetation growth and/or infiltration of runoff and intercepted flow. **b.** Consider re-contouring highly unstable portions of road. **c.** Re-vegetate disturbed areas, particularly at or near stream crossings. Coordinate type and species of vegetation, along with any amendments, with the forest botanist. **16.** Closure method at the entrance to the stored road is commensurate with the terrain, alternate uses, and extent of time road is expected to be stored. Stored roads are not shown on the motor vehicle use map, thereby prohibiting motor vehicle use. Use gates or barriers as appropriate for the site. Sign the closure as necessary to inform the public. **17.** Regularly perform condition surveys to monitor and evaluate the effectiveness of the closure measures.
2.7	Road Decommis-sioning	Stabilize, restore, and vegetate unneeded roads to a more natural state as necessary to protect and enhance NFS lands, resources, and water quality. The end result is that the decommissioned road will not represent a significant impact to water quality by: 1. Reducing erosion from road surfaces and slopes and related sedimentation of streams; 2. Reducing risk of mass	Roads no longer needed are identified during transportation planning activities (see description of Travel Management subpart A in BMP 2.1) at the forest, watershed or project level. The unneeded road may be decommissioned, or converted to a trail or other use as appropriate. Temporary roads constructed for a specific short-term purpose (for example, ski area development, minerals exploration, or vegetation extraction) are decommissioned at the completion of their intended use, and vegetation reestablished within 10 years. Road decommissioning terminates the use of the road as a road, and as such, treatments can range from simply blocking the road entrance, to totally eliminating the road	**Implementation:** **1.** Engineering and hydrology personnel conduct field review of road selected for decommissioning to determine site characteristics: aspect, soil type(s), topography, surrounding vegetation, proximity to water sources, and so forth. **2.** Optimize treatments that will achieve long-term watershed protection goals on individual roads to stretch the available funds for road decommissioning over as many miles as practicable. 3. Weigh benefits and costs of treatments against alternative of placing road in storage and costs for continuing to maintain for hydrologic functionality. See BMP 2.1. **4.** Prepare and implement an approved erosion and sediment control plan for both temporary and long-term recovery of the site as specified. **5.** Outslope road by pulling back unstable or perched fill.

BMP #	Title	Objective	Summary Explanation	Implementation
		failures and subsequent impact on water quality; 3. Restoring natural surface and subsurface drainage patterns; 4. Restoring stream channels at road crossings and where roads run adjacent to channels.	prism and structures, and restoring the land to original contours. Treatment method is carefully chosen to minimize negative impacts to water quality, reestablish vegetation, and restore ecological processes. More aggressive techniques may include greater and longer term risks to water quality through exposure of larger disrupted soil surfaces. Road decommissioning can be accomplished by using the appropriate techniques from the list in the right-hand column adapted as needed to local site conditions.	**Remove berms.** **1.** Restore stream courses and floodplains where feasible, to natural grade and configuration. **2.** Remove drainage structures determined as necessary to protect water quality: **3.** Re-contour disturbed fill material, and compact minimally to allow filtration. **4.** Re-contour the road surface cut and fill slopes to restore natural hillslope topography where specified. **5.** De-compact areas with stable fill but reduced infiltration and productivity. **6.** Haul excess fill to stable disposal areas outside of the SMZ. **7.** Provide effective soil cover (such as mulch, woody debris, rock, vegetation, blankets) to exposed soil surfaces for both short- and long-term recovery. **8.** Revegetate disturbed areas, particularly at or near stream crossings. **9.** Block vehicle access to prevent motorized traffic, in conjunction with signing, publication, and enforcement of the forest's motor vehicle use map.
2.8	Stream Crossings	Minimize water, aquatic, and riparian resource disturbances and related sediment production when constructing, reconstructing, or maintaining temporary and permanent water crossings.	Stream crossings present the highest risk to water quality associated with roads. Forest management activities often occur in areas that require surface waters to be crossed. Depending on the activity type and duration, crossings may be needed permanently or temporarily. Permanent crossings are designed to meet applicable standards while also protecting water, aquatic, and riparian resources. Examples of crossings include culverts, bridges, arched pipes, low water crossings,	If stream crossings are constructed, reconstructed, or maintained by force account crews, the project manager and foreman are responsible for adherence to project drawings, specifications, and Erosion Control Plan. The forest hydrologist works in conjunction with engineering and administrative personnel to provide additional monitoring and evaluation during implementation, as needed. **Location and Design:** **1.** Locate roads in an interdisciplinary manner with a hydrologist, soils scientist, and geologist if necessary.

BMP #	Title	Objective	Summary Explanation	Implementation
			fords, vented fords, and permeable fills. Crossing materials and construction will vary, based on the type of access required and volume of use expected. Optimally, crossings should be designed and installed to provide passage for the flow of water plus anticipated sediment and debris, provide for desired aquatic organism passage, and minimize disturbance to the surface and shallow groundwater resources. Sizing is based on a weighed balance between providing for larger storm events, and cost feasibility, while still meeting other resource objectives. Construction, reconstruction, and maintenance of a water crossing usually requires heavy equipment to be in and near streams, lakes, and other aquatic habitats to install or remove culverts, fords and bridges and their associated fills, abutments, piles, and cribbing. Such disturbance near the waterbody can increase the potential for accelerated erosion and sedimentation from destabilization of streambanks or shorelines, vegetation and ground cover removal, and soil exposure or compaction. In addition, heavy equipment has potential for contamination of the surface water from vehicle fluids. Permits may be required for in-stream work associated with stream crossing construction and maintenance projects. There are specific requirements for such projects under the Clean Water Act and implementing	**2.** Plan and locate surface water crossings to limit the number and extent required to service the activity. **3.** Design the stream crossing to pass the 100-year flood flow plus associated sediment and debris; armor to withstand design flows and to provide desired passage of fish and other aquatic organisms. **4.** Locate and design crossings to minimize disturbance to the waterbody. **5.** Use structures appropriate to the site conditions and traffic levels: **a.** Favor bridges, bottomless arches, or buried pipe-arches for those streams with identifiable floodplains and elevated road prisms, instead of pipe culverts. **b.** Place bridge and arch footings below the scour depth for the 100-year flood flow plus the appropriate factor of safety. **c.** Favor armored fords for those streams where vehicle traffic is either seasonal or temporary, or the ford design maintains the channel pattern, profile and dimension. **d.** For perennial streams, use vented fords, so that the crossing can pass low flows. **6.** See BMP BMP 2.2: General Guidelines for the Location and Design of Roads, for further guidance. **Construction and reconstruction - permanent and temporary crossings:** **1.** Implement the approved erosion control plan that covers all disturbed areas, including borrow areas, stockpiles,

BMP #	Title	Objective	Summary Explanation	Implementation
			regulations. State and local entities may also provide guidance and regulations. The risk from construction, reconstruction or maintenance of stream crossings can be managed by using the appropriate techniques from the following list adapted as needed to local site conditions.	stream diversions, etc. used during stream crossing construction or reconstruction (see BMP 2.13- Erosion Control Plan). **a.** Use temporary filters, berms, barriers, conveyances or other materials to collect sediment and prevent it from entering surface waters. **b.** Set the minimum construction limits needed for the project and confine disturbance to within this area. **2.** Accurately establish and preserve vertical control through design invert and outlet elevations on site for each crossing, to assure that the constructed stream-crossing structure will perform as intended, and promote effective drainage without damage or impact to water, aquatic, or riparian resources. **3.** Accurately establish and preserve horizontal alignment for each stream-crossing structure, to assure that flows do not erode stream banks or shoreline. **4.** Install stream crossings according to project design specifications and drawings. Design should sustain bankfull dimensions of width, depth and slope, and maintain streambed and bank resiliency. **5.** Minimize streambank and riparian area excavation during construction: **a.** Stabilize adjacent areas disturbed during construction using surface cover (mulch), retaining structures, and or mechanical stabilization materials. **b.** Keep excavated materials out of channels, floodplains, wetlands, and lakes. **c.** Install silt fences or other sediment- and debris-

BMP #	Title	Objective	Summary Explanation	Implementation
				retention barriers between the water body and construction material stockpiles and wastes. **6.** Bypass roads for use during construction are considered temporary roads, and are subject to the all relevant BMPs. Decommissioning and stabilization of the bypass roads are inherent in the project plan. **7.** Ensure imported fill materials meet project specifications, and are free of toxins and invasive aquatic or riparian species. **8.** To the extent possible, conduct operations during the least critical periods for water and aquatic resources: when streams are dry; during low-water conditions; in compliance with spawning and breeding season restrictions. **9.** Divert or dewater stream flow for all live streams or standing waterbodies during crossing installation and invasive maintenance: **a.** Return clean flows to channel or water body downstream of the activity. **b.** Restore flows to their natural stream course as soon as possible after construction or prior to seasonal closures. **c.** Install downstream collection basins, retention facilities, or filtering systems as needed to capture and retain turbid water. **d.** Remove collected sediment as needed to maintain their design capacity during the life of the project. **10.** Construct diversion prevention dips to accommodate overtopping of runoff if diversion potential exists, when shown on project drawings and specifications. Locate

BMP #	Title	Objective	Summary Explanation	Implementation
				diversion prevention dips downslope of the crossing rather than directly over crossing fill; if designed, armor diversion prevention dips based on soil characteristics and potential risk. **11.** Install cross drains (for example, rolling dips; waterbars) to hydrologically disconnect the road above the crossing and to dissipate concentrated flows. **12.** Remove all project debris from the water body in a manner that will cause the least disturbance. **13.** Dispose of unsuitable material in approved waste areas outside of the SMZ. **14.** Clean equipment used for instream work prior to entering the water body: **a.** Remove external oil, grease, dirt and mud from the equipment and repair leaks prior to arriving at the project site. **b.** Inspect all equipment before unloading at site. **c.** Inspect equipment daily for leaks or accumulations of grease, and correct identified problems before entering streams or areas that drain directly to waterbodies. **d.** Remove all dirt and plant parts to ensure that noxious weeds and aquatic invasive species are not brought to the site. **15.** Fuel and service equipment used for in-stream or riparian work (including chainsaws and other hand power tools) only in designated areas (see BMP 2.10). **16.** Fully suspend logs, pipes, posts and other transported

BMP #	Title	Objective	Summary Explanation	Implementation
				materials when crossing waterbodies and SMZs. **17.** Restore the original surface of the streambed, lake bottom, or wetland upon completing the crossing construction or maintenance. Construct the surface of the streambed according to project specifications and drawings for aquatic passage projects. Stockpile materials by strata or as indicated by specified design criteria when extensive dredging or excavation of these substrates is required. **18.** Stabilize streambanks, shorelines, cut and fill slopes, turnouts, and other disturbed areas adjacent to the water resource following crossing installation or maintenance: **a**. Use riprap or rock, wood, vegetation, and other native materials as appropriate. **b.** Install riprap or other slope protection to prevent erosion from water movement. **c.** Size rock slope protection for the 100-year flood flow. **d**. Use appropriate construction techniques (keying in riprap) and underlayments (filter blankets or other geotextile) to prevent undermining. **e.** Ensure stone used for riprap is free of weakly structured rock, soil, organic material, and other material not resistant to erosive water action. **f.** Place stable materials below drainage outlets on erodible soils to dissipate energy. **19.** Provide effective soil cover (mulch, woody debris, rock, vegetation, blankets) on exposed soil surfaces for both short- and long-term recovery.

BMP #	Title	Objective	Summary Explanation	Implementation
				20. Revegetate disturbed areas. **21**. Stabilize temporary crossings that must remain in place during high-runoff seasons. **22**. Remove temporary crossings and restore the waterbody profile and substrate when the need for the crossing no longer exists. **Maintenance:** **1**. Implement the approved erosion control plan that covers all disturbed areas, including borrow areas, stockpiles, stream diversions used during stream-crossing maintenance and culvert cleaning (see BMP 2.13- Erosion Control Plan). **2**. Use temporary filters, berms, barriers, conveyances, or other materials to collect sediment and prevent it from entering surface waters. **3.** Remove all project debris from the stream or creek in a manner that will cause the least disturbance. **4**. Dispose of unsuitable material in approved waste areas outside of the SMZ. **5.** Clean equipment used for instream work prior to entering the stream/creek. **a.** Remove external oil, grease, dirt and mud from the equipment, and repair leaks prior to arriving at the project site. **b.** Inspect all equipment before unloading at site. **c.** Inspect equipment daily for leaks or accumulations of grease, and correct identified problems before entering

BMP #	Title	Objective	Summary Explanation	Implementation
				streams or areas that drain directly to waterbodies. **d.** Remove all dirt and plant parts to ensure that noxious weeds and aquatic invasive species are not brought to the site. **6.** Fuel and service equipment used for in-stream or riparian work (including chainsaws and other hand power tools) only in designated areas (see BMP 2.10). **7.** Maintain and remove buildup of sediment and debris in diversion prevention dips, rolling dips, and waterbars to ensure they are functioning properly, and do not contribute to the hydrological connectivity of the road. **8.** Ensure that inside ditches are maintained properly, and are relieved at regular intervals to eliminate hydrological connectivity. See BMP 2.4, Road Maintenance and Operations.
2.9	Snow Removal and Storage	Prevent or reduce erosion, sedimentation, and chemical pollution that may result from snow removal and storage activities.	Forest roads and parking areas are sometimes used in areas that receive snow. Snow removal from these facilities may adversely affect water; aquatic, and riparian resources in several ways. Plowing may physically displace native or engineered surfaces on roads, damage drainage structures, or alter drainage patterns. Plowing may also remove protective soil cover (for example, vegetation and mulch). These changes can result in concentrated flow, increased erosion, and a greater risk of sediment delivery to waterbodies. Snow piled in large heaps or in sensitive areas may contribute to increased run-off,	**Implementation:** **1.** Review the forest's wet weather operations standards. See BMP 2.13. **2.** Prepare a winter road maintenance plan for roads and parking facilities routinely subject to snow removal operations. Include an erosion and sediment control component to address the following, particularly when no other alternatives exist: **a.** Snow storage areas that could impact water bodies, riparian areas, wetlands, floodplains, and streams. **b.** Fill slopes subject to erosion. **c.** Snow storage locations whose runoff could overwhelm drainage features. **d.** Winter logging operations. **e.** Traditional snow play and winter recreation areas, including those under permit. **f.** Snow-park locations.

BM P #	Title	Objective	Summary Explanation	Implementation
			hill slope erosion, mass slope instability, and in-channel erosion from snowmelt. Snow stored in riparian areas and floodplains may compact soils, break or stunt vegetation, or channel runoff in undesirable patterns, thereby weakening the buffering capacity of areas. Additionally, both snow removal and storage may result in additions of nutrients or fine aggregates used for de-icing or traction control directly to surface water and indirectly to both surface water and groundwater during runoff. The risk from snow removal and storage can be managed by using the appropriate techniques from the following list adapted as needed to local site conditions.	**g.** Administrative access. **h.** Store snow in pre-approved areas where snowmelt will not cause erosion or deposit snow, road de-icers, or traction enhancing materials directly into surface waters. **i.** Plan as though snowmelt from snow storage is the equivalent of an intense localized rainfall. **j.** Mark drainage structures to avoid damage during plowing. **3.** Move snow in a manner that will prevent disturbance of road surfaces and drainage structures, while protecting adjacent water; aquatic and riparian resources. 4. Control areas where snow removal equipment can operate to prevent damage to riparian areas, floodplains, and stream channels. **5.** Install snow berms where such placement will preclude concentration of snowmelt runoff and will serve to rapidly dissipate melt water. Provide frequent drainage through snow berms to avoid hydrologic connectivity with surface waters, concentration of snowmelt runoff on fillslopes and other erosive areas, to dissipate melt water, and to prevent sediment delivery to waterbodies. **6.** Limit use of approved deicing and traction-control materials, but do not compromise in areas where safety is critical (intersections and approaches, steep segments, corners). **a.** Do not over-apply these materials, and limit spray distribution, when near surface waters. **b.** Design paved roads and parking lots to facilitate sand removal (with curbs or paved ditches). **7.** Conduct frequent inspections at the earliest possible opportunity to ensure road drainage is not adversely affecting soil or water resources. **8.** Where feasible, discontinue road use and snow removal when sediment delivery, or threat thereof, is occurring.

BM P #	Title	Objective	Summary Explanation	Implementation
				9. Replace lost road surface materials with similar quality material and repair structures damaged in snow removal operations as soon as practicable and as funding allows. **10.** Develop a snow removal plan for roads with winter-logging operations, or roads plowed for recreation, administrative or other access, either by force account or contract, to provide written guidelines on how to implement these techniques, and to provide a map that includes: **a.** Locations of drainage structures **b.** Locations of streams **c.** Control areas for equipment **d.** Pre-approved snow storage areas **e.** Locations to avoid **11.** Federal Land Policy and Management Act easements shall include best management practices for snow removal for roads where snow removal and storage affects NFS land, providing access to non-forest users (residential areas). **12.** Modify snow removal procedures as necessary to meet water-quality concerns.
2.10	Parking and Staging Areas	Construct, install, and maintain an appropriate level of drainage and runoff treatment for parking and staging areas to protect water, aquatic, and riparian resources.	Designated parking and staging areas on NFS lands may be permanent or temporary and are associated with a variety of uses including administrative buildings, developed recreation sites, trailheads, off-highway vehicle (OHV) areas, and management projects. These parking facilities sometimes constitute large areas with little or no infiltration capacity. Runoff from these areas can create rills or gullies, and carry sediment, nutrients, and other pollutants to nearby surface waters. The risk from parking and staging areas can be managed by using the appropriate techniques from the right-hand column adapted as	**Implementation:** **1.** Design and locate parking and staging areas of appropriate size and configuration to accommodate expected vehicles and prevent damage to adjacent water; aquatic, and riparian resources. **a.** Avoid sensitive areas such as riparian areas, wetlands, meadows, bogs, fens, inner gorges, overly steep slopes, and unstable landforms to the extent practicable. **b.** For staging areas, designate specific locations for fueling so that water-quality impacts are minimized. **2.** Consider the number and type of vehicles to determine parking or staging area size. **a.** Calculate the expected runoff generated using the appropriate design storm to determine necessary drainage based on the size of the parking or staging area.

BM P #	Title	Objective	Summary Explanation	Implementation
			needed to local site conditions.	**b.** Consider run-on from any contributing areas. **3.** Provide signage to designate parking, staging, and refueling areas, and to minimize impacts to sensitive areas. **4.** Use permeable pavements where possible, and integrate vegetative islands to trap and filter runoff. **5.** Infiltrate as much of the runoff as possible using permeable surfaces and infiltration ditches or basins in areas where groundwater contamination risk is low. **6.** Pave parking areas that experience heavy use and those that are used during wet periods. **7.** Install curbs and gutters to direct and capture surface flow from these paved surfaces. **8.** Install and maintain oil and grease separators in larger parking lots with high use and where drainage discharges directly to streams. **9.** Plan for necessary clean out and disposal of material collected in these vaults. **10.** Connect drainage system to existing stormwater conveyance systems where available and desirable. **11.** Conduct maintenance activities commensurate with parking or staging area surfacing and drainage requirements as well as precipitation timing, intensity, and duration. **12.** Limit the size and extent of temporary parking or staging areas. **13.** Take advantage of existing openings, sites away from waterbodies, and areas that are apt to be more easily restored. **14.** Rehabilitate temporary parking or staging areas immediately following use. **15.** Effectively prevent access to the area once site restoration activities have been completed. **16.** Consider the need to upgrade roads that access parking areas such as OHV parking areas or snow play areas.
2.11	Equipment	Prevent fuels, lubricants,	Many activities require the use and	**Implementation:**

BMP #	Title	Objective	Summary Explanation	Implementation
	Refueling and Servicing	cleaners, and other harmful materials from discharging into nearby surface waters or infiltrating through soils to contaminate groundwater resources.	maintenance of petroleum-powered equipment in the field: vegetation harvest and regeneration; road, trail, and facility construction, reconstruction, and maintenance. The activities often employ equipment that uses or contains gasoline, diesel, oil, grease, hydraulic fluids, antifreeze, coolants, cleaning agents, and/or pesticides. These petroleum and chemical products may pose a risk to surface water and groundwater during refueling and servicing the equipment. Risk from fuel and chemical spills during equipment refueling or servicing can be managed by using the appropriate techniques from the right-hand column adapted as needed to local site conditions. Implementation:	**1.** Plan for appropriate equipment refueling and servicing sites during project planning and design. **2.** Allow temporary refueling and servicing only at approved locations, which are well away from water or riparian resources. **3.** Develop or use existing fuel and chemical management plans (for example, spill prevention control and countermeasures (SPCC), spill response plan, emergency response plan) when developing the management prescription for refueling and servicing sites. **4.** Locate, design, construct, and maintain petroleum and chemical delivery and storage facilities consistent with local, State and Federal regulations. **5.** Install contour berms and trenches around vehicle service and refueling areas, chemical storage and use areas, and waste dumps to fully contain spills. **6.** Use liners as needed to prevent seepage to groundwater. **7.** Provide training for all personnel handling fuels and chemicals in their proper use, handling, storage, and disposal. **8.** Avoid spilling fuels, lubricants, cleaners, and other chemicals during handling and transporting. **9.** Prohibit excess chemicals or wastes from being stored or accumulated in the project area. **10.** Remove service residues, waste oil, and other materials from NFS land and properly dispose them following completion of the project. 11. Clean up and dispose of spilled materials according to specified requirements in the appropriate guiding document. **12.** Report spills and initiate appropriate clean-up action in accordance with applicable State and Federal laws, rules and regulations. The forest hazardous materials coordinator's name and phone number shall be available to Forest Service personnel who administer or manage activities utilizing

BM P #	Title	Objective	Summary Explanation	Implementation
				petroleum-powered equipment. **13.** Remove contaminated soil and other material from NFS lands and dispose of this material in a manner according to controlling regulations. **14.** Prepare a certified SPCC Plan for each facility, including mobile and portable facilities that have oil storage capacity of at least 1,320 gallons in containers 55 gallons or greater. **a.** Install or construct the containment features or countermeasures called for in the SPCC Plan to ensure that spilled oil does not reach groundwater or surface water. **b.** Ensure that each SPCC Plan includes a spill contingency plan at each facility that is unable to provide secondary spill containment. **c.** Ensure that clean-up of spills and leaking tanks complies with Federal, State and local regulations and requirements. **15.** Prepare a contingency plan when quantities of petroleum products are capable of violating Basin Plan water-quality objectives. **16.** Section H clauses for Public Works Construction include a standard clause for Spill Plan when project or activity includes oil or oil products storage exceeding 1,320 gallons, or a single container exceeding 660 gallons. Section H clauses also require designation of contractor's key personnel, including authorized on-site representative and phone number(s).
2.12	Aggregate Borrow Areas	Minimize disturbance to water, aquatic, and riparian resources when developing and using aggregate borrow sites.	Materials deposited along channels and in floodplains during high flows and storm runoff can provide a source of aggregates such as gravels, cobbles, and boulders for some management activities. Many of these aggregate deposits also include finer materials such as sand, silt, clay, and organic	**Implementation:** **1.** Determine the limits of disturbance for extraction such that water and adjacent water-dependent resources are protected. **2.** Determine safe periods of use and limit extraction to those periods. **3.** Install temporary barriers between the extraction area and

BMP #	Title	Objective	Summary Explanation	Implementation
			debris that can be mobilized during or following desired material-extraction operations. Additionally, the location of these deposits may require equipment to pass over or through water courses or riparian areas, increasing the potential for bed, bank, riparian, and aquatic habitat disturbance. Adequate planning is necessary to minimize adverse impacts on water, aquatic, and riparian resources; natural geomorphic processes; and existing infrastructure while removing aggregate deposits. The size and location of the deposit, as well as the amount and duration of need for materials, are commonly the key factors to consider when evaluating and designing an appropriate strategy to remove the materials and stabilize the site following extraction. We can manage the risk to water-quality impacts from aggregate borrow activities by using the appropriate techniques from the right-hand column adapted as needed to local site conditions.	surface waters to prevent sedimentation. **4.** Provide for appropriate soil and stream crossings, as necessary, while working in the SMZ and waterbodies. **5.** Develop detailed mitigation measures to stabilize and restore the borrow area to desired conditions for the site. **6.** Ensure that areas restored within active channels and floodplains will be stable and function as expected under higher flows.
2.13	Erosion Control Plan	Effectively limit and mitigate erosion and sedimentation from any ground-disturbing activities, through planning prior to commencement of project activity, and through project management and administration during	Ground-disturbing activities can result in erosion and sedimentation. By effectively planning for erosion control, sedimentation can be controlled or prevented. Engineering and hydrology personnel jointly develop mitigation recommendations and preliminary BMPs using an interdisciplinary team during the project planning process and environmental analysis phase. Erosion control plans are not be confused with design features whose primary objective is to	Ground-disturbing activities will be exempt from the requirement to prepare an erosion control plan under any of the four exemption categories below: **1.** Area-based - less than 50 square feet in riparian area; less than 10,000 square feet in a non-riparian area; **2.** Activity-based - activities conducted under a categorical exclusion with no wheeled or tracked equipment, or included under North Coast Regional or State waiver Category A; **3.** Site-condition criteria - project locations that are: outside of riparian areas and on soils with high infiltration rates

BMP #	Title	Objective	Summary Explanation	Implementation
		project implementation. 1. Provide seamless transition between planning-level (NEPA) mitigation descriptions and on-the-ground implementation of erosion-control measures tailored to site conditions. 2. Ensure that all disturbance-related mitigation requirements and provisions for field revisions or modifications are accurately captured in one comprehensive document for each project or activity. 3. Activities include, but are not limited to: timber sale harvest; facility site, road, bridge, trail and appurtenance construction, reconstruction, and maintenance; watershed improvement; road and trail decommissioning; legacy site restoration, administratively permitted activities; and vegetation and fuels	provide or improve water quality, such as a bridge; reinforced earth retaining wall; or landscaping. The long-term mitigation objectives are typically described in the NEPA document for the project, and then refined in project drawings and specifications as design features. Short-term mitigation measures to prevent erosion and sedimentation are described in detail in the project's erosion control plan. Project mitigations are conceptually described in NEPA analyses but are typically generic. Detailed mitigation measures are based on site-specific surveys, conditions, and characteristics, and are developed in the project design phase. They are ultimately displayed in the project document's design documents (specifications and drawings) based on site-specific surveys, conditions, and characteristics. Furthermore, field personnel have the responsibility to make refinements or additional recommendations to adjust to actual current and predicted future conditions. This flexibility is a necessary and desirable component of project implementation, but must ultimately result in implementation of requirements to protect soil and water quality. To ensure that all required and relevant mitigation measures are documented and implemented, an environmental control plan will be prepared to complement design (design addresses required mitigations specified in NEPA documents), site-specific	(more than 2 inches per hour) and on slopes less than 15 percent. **4.** Flexibility criteria - any activity approved by the forest hydrologist with documentation explaining the rationale for the exemption. BMP checklists will be prepared for all projects (see section 16) even if an erosion control plan is not necessary. Erosion control plans for any ground-disturbing activity not meeting the exemption categories above will be reviewed and recommended by the forest hydrologist, and approved and signed by the District Ranger. The hydrologist's recommendation and signature indicates that all mitigation measures prescribed in environmental documents and project plans, or resource specialist's recommendations are included on the environmental control plan. The Forest Supervisor will approve and sign the environmental control plan for forestwide ground-disturbing activities, such as annual road maintenance. All forests shall develop wet weather operations standards (WWOS). The purpose of the WWOS is to provide guidance with the end result of preventing significant adverse impacts to water quality from wet weather operations on NFTS roads and trails. Such operations may include winter hauling, fuelwood gathering, public access for hunting or Christmas tree cutting, administrative access on closed roads for springtime burning of slash piles, reforestation activities, snow plowing, or other ground disturbance outside normal operating season. WWOS must include notification protocols for informing resource specialists (hydrologists, biologists, soil scientists) as well as line officers prior to initiation or continuation of a project or activity into wet weather season. Project field operations cannot begin until the District Ranger approves and signs the plan. The erosion control

BMP #	Title	Objective	Summary Explanation	Implementation
		management activities. 4. Comply with overarching area plans, such as Northwest Forest Plan and Sierra Nevada Framework Plan Amendment.	prescriptions, and amended to include changes made in the field. Detailed and accurate environmental control plan will allow Forest Service and Water Board staff to conduct efficient, meaningful inspections of ground-disturbing projects, and will provide a needed check to ensure that mitigation measures for addressing impacts from the activities are accurately communicated to field staff.	plan will be kept on site during project activity and made available for review upon request of a representative of the Water Board or any local storm water management agency which receives the storm water discharge. The erosion control plan shall be amended if there is a change in control practices, site conditions, or BMPs that may result in less water-quality protection than specified in the project's environmental document, project plan, accepted erosion control plan, or permit/waiver. The amendment must include: name of person requesting the change; a description of the change, including revised BMPs or control practices to mitigate the effects of the change; and why the change is needed. Even the best erosion and sediment control plan cannot cover the specifics of each situation that will arise on a site during the life of a project. All parties involved in the project have a role and responsibility to ensure the activity complies with the goals or intent of the erosion control plan at all times. All temporary erosion and sediment control practices must be maintained and repaired as needed to assure continued performance of their intended function. **Erosion Control Plan Contents** **1.** Erosion and Sediment Control shall include: **a.** List of anticipated ground-disturbing actions associated with the project (for example, stream diversion; exposed cut slopes; stripped and stockpiled topsoil; water source development or use) **b.** Checklist which includes mitigation measures required by project NEPA, and in some cases CEQA documents, requirements to meet BMPs, project plans, specifications, and permits, if any. The selection of erosion and sedimentation control measures shall be based on assessments of site conditions and how storm events may contribute to erosion. Control measures will be selected

BMP #	Title	Objective	Summary Explanation	Implementation
				from the references provided in the On-Line Library at the end of section 12 of the USFS source document, or will be of equivalent effectiveness as the measures described in those references. **c.** Illustrations of control practices designed to prevent erosion and sedimentation. Illustrations must show construction and installation details for control practices, and must be included in the erosion control plan. (for example, California Stormwater Quality Association BMP standard specifications CASQA at http://www.cabmphandbooks.com, or Caltrans Stormwater and Water Pollution Control guides at http://www.dot.ca.gov/hq/construc/stormwater/stormwater1.htm) **d.** Map/drawing(s) showing soil or water buffer zones, RCAs, RCHAs, SMZs or other soil or water protection areas to be protected from project activities. Project boundary extends beyond disturbance limits. **e.** A description of the color and/or pattern of flagging or marking for soil or water buffer zones, RCAs, RCHAs, SMZs or other soil or water protection areas for each unit. **f.** Relevant sections from the forest's WWOS that apply to activity/activities. The WWOS will provide guidance to prevent significant adverse impacts to water quality from wet weather operations on NFTS roads and trails. **i.** Forest motor vehicle use map will be used to determine seasonal closures for all NFTS routes that are not under permit or for administrative use only. **(1)** A storm preparedness plan that describes additional control practices to be implemented when the National Weather Service predicts a 50 percent or greater chance of precipitation. **(2)** A winterization plan that describes additional control practices to be implemented to stabilize the site

BMP #	Title	Objective	Summary Explanation	Implementation
				during periods of seasonal inactivity. The dates vary by locality, and may be determined by the individual RWQCB (for example, October 15 through May 1). "Winterized" means that the site is stabilized to prevent soil movement permanently if project activities are complete, or temporarily in a manner which will remain effective until end of the stabilization period. **(3)** If winter activity, including over-snow operation is proposed, specifications for snow/ice depth or soil operability conditions must be described. **g.** Control practices to reduce the tracking of sediment onto paved roads. These roads will be inspected and cleaned as necessary. **h.** Control practices to reduce wind erosion and control dust. **i.** A proposed sequential schedule to implement erosion and sediment control measures, in addition to the general construction schedule. **j.** Location information, including directions to access the project area. Include a scaled map, with road names/numbers. **k.** Contact information of project personnel, including name and cell phone number (that is, sale administrator, contracting officer's representative, project manager, project supervisor, contractor, site superintendent, hydrologist, permit administrator and so forth) **2.** Maps requirements: Maps must be clear, legible, and of a scale such that depicted features are readily discernable. For example, sale area maps may be used to satisfy the mapping requirements outlined in **b.ii**, below, if they meet this intent. **a.** As a means of determining BMPs and erosion control measures, a topographic map should be in the project file. The map should extend beyond the boundaries of the project site, showing the project site boundaries, and surface and subsurface water bodies (ephemeral and intermittent waters,

BMP #	Title	Objective	Summary Explanation	Implementation
				springs, wells, and wetlands) that could be at risk of water-quality impacts from project activities. **b.** For timber harvest activities, unit-specific map(s) shall be scaled no smaller than 1 inch equals 1,000 feet (1:12,000). For all other activities, maps shall be scaled to provide legible interpretation of requirements shown above. All maps shall include: **(1)** Specific locations of storm water structures and controls used during project activities. **(2)** Erosion hazard ratings for each unit, specified down to 20 acres if different EHRs exist within each unit. **(3)** Locations of existing and proposed haul roads, watercourse crossings, skid trails, and landings. **(4)** Locations of post-project storm water structures and controls. **(5)** Equipment access, storage, and service areas. **3.** Diversion of Live Streams: If the project involves stream diversions for crossing construction, the erosion control plan must include detailed plans for these activities, including storm contingencies. See BMP 2.8 - Stream Crossings. **4.** Non-Storm Water Management: The erosion control plan shall include provisions which eliminate or reduce the discharge of materials other than storm water to the storm sewer system and/or receiving waters. Such provisions shall ensure that discharged materials shall not have an adverse effect on receiving waters. Materials other than storm water that are discharged shall be listed, along with the estimated quantity of the discharged material. **5.** Waste Management and Disposal: The erosion control plan shall describe waste management and disposal practices to be used at the project site. All wastes (including equipment and maintenance waste) removed from the site for disposal shall be disposed of in a manner that is in compliance with Federal, State, and local laws, regulations,

BMP #	Title	Objective	Summary Explanation	Implementation
				and ordinances. Include plan for project-specific activities that produce waste products, such as concrete truck/chute/pump washout, equipment servicing, equipment washing, and so forth. **6.** Maintenance, Inspection, and Repair: The erosion control plan shall include inspection, maintenance and repair procedures to ensure that all pollution-control devices identified in the erosion control plan are maintained in good and effective condition and are promptly repaired or restored. A qualified person shall be assigned the responsibility to conduct inspections. The name and telephone number of that person shall be listed in the erosion control plan. A tracking and follow-up procedure shall be described to ensure that all inspections are done by trained personnel and that adequate response and corrective actions have been taken in response to the inspection. This procedure may be in the form of a written checklist, with inspections signed and dated. Photo documentation is encouraged. **7.** Other Plans: This erosion control plan may incorporate, by reference, the appropriate elements of other plans required by local, State, or Federal agencies. A copy of any requirements incorporated by reference shall be kept in the project file. **8.** Post-Project Storm Water Management: The erosion control plan shall describe the storm water control structures and management practices that will be implemented to minimize pollutants in storm water discharges after project activity phases have been completed at the site. It shall also specify controls to be removed from the activity site(s) and methods for their removal. The discharger must consider site-specific factors and seasonal conditions when designing the control practices that will function after the project is complete.

BM P #	Title	Objective	Summary Explanation	Implementation
				9. Preparer: The erosion control plan shall include the title and signature of the person responsible for preparation of the erosion control plan, the date of initial preparation, and the person and date responsible for any amendments to the erosion control plan. **10.** Template: The Forest Service will develop sample templates for erosion control plans based on activity type. Complexity of the template will be commensurate with the degree of risk to impact water quality by the activity.
4.7.1	OHV Planning	To use the travel management planning processes, including travel analysis, to develop measures to avoid, minimize, and mitigate adverse impacts to water, aquatic, and riparian resources during OHV management activities, and to identify restoration for OHV-damaged areas and trails not designated for use.	The amount, type, and location of OHV trails are determined through various planning processes. OHV trail planning includes travel analysis as well as trail management at the project level. Planning occurs at scales that can range from forestwide assessments and plans, to watershed-scale analyses, to project-level trail activities. During planning, potential effects on water, and on aquatic and riparian resources are identified, and protection and mitigation measures are proposed. Trail management objectives are developed to define the type of recreation experience each trail is designed to provide, and to provide direction on management of the trail. In addition to guiding trail management at the site-specific scale, TMOs also document Forest-wide trail maintenance needs and identify the potential for environmental effects and conflicts with other resources. The risk from OHV trail management activities can be reduced by using the appropriate techniques from the column to the right, adapted as needed to local site	**Implementation:** **1.** Conduct travel analysis to determine the appropriate trail system for the recreational objective. Plan trails to: a. Minimize the number of stream crossings **b.** Avoid locations near wetlands (for example, seeps, springs, marshes, and wet meadows) **c.** Favor existing trails over new construction when less damage to water quality will occur **2.** To the degree feasible, locate new construction on natural benches, flatter slopes, and stable soils. Avoid locating new trails on: **a.** Areas prone to mass wasting **b.** Slopes steeper than 55 percent **c.** Slopes steeper than 45 percent where the erosion potential is high or extreme Limit steep pitches to less than 200 feet where possible. **3.** Identify trail segments causing adverse impacts to water resources and prioritize mitigation measures such as: **a.** Relocate existing trails or trail segments that are in high-risk locations, including SMZs, riparian areas, and meadows, to restore surface and subsurface hydrologic function **b.** Reconstruct trails to improve, modify, or restore effective drainage

BMP #	Title	Objective	Summary Explanation	Implementation
			conditions.	**c.** Upgrade stream crossings **d.** Develop or update a trail management objective for each trail: **e.** Define the recreation experience and level of difficulty the trail is designed to provide. **f.** Identify current and future needs and uses of each authorized trail in the trail management objective. **g.** Determine whether existing trail design standards are adequate to support the defined recreational experience, and whether impacts to water, aquatic, and riparian resources are likely to result from not following trail management objectives. **h.** Identify trails that are managed differently and/or are serving purposes other than those identified in trail management objectives. Modify the objective to match the intended use and management of the trail. **i.** Operate the trail as intended by the trail management objectives until they are revised and/or the trail is reconstructed to accommodate different uses.
4.7.2	OHV Trail Location and Design	To reduce the risk that sediment originating from designated OHV trails and OHV areas will enter watercourses and water bodies by locating OHV trails to minimize hydrologic connectivity, and by incorporating drainage structures into trail design to disperse concentrated runoff.	Proper on-site location and design of OHV trails are essential, particularly at stream crossings (see BMP 4.3). The amount of sediment delivered to a water body from an OHV trail is affected by runoff concentration and hydrologic connectivity. Properly located and designed drainage structures disperse concentrated runoff. Typically, runoff as overland flow will not penetrate a buffer strip, but runoff concentrated in rills or gullies will. **1.** The potential to deliver sediment originating from OHV trails and OHV areas to watercourses and water bodies is a	**Trail Location:** 1. Locate trails and drainage structures to minimize hydrologic connectivity. 2. Limit the number of watercourse crossings to those needed to meet the recreational objective. 3. Maximize the filter distance between the trail and the water body. 4. Locate drainage structures where dispersion or absorption of runoff is effective. 5. Avoid sensitive areas such as riparian areas, wetlands, meadows, bogs, fens, inner gorges, and unstable landforms. 6. Avoid the capture, diversion, and/or concentration of runoff from slopes adjacent to OHV trails.

BMP #	Title	Objective	Summary Explanation	Implementation
			function of the: **a.** number, location, and design of watercourse crossings **b.** volume and energy of concentrated flow leaving the trail or area **c.** ability of the intervening terrain to absorb or disperse concentrated flow, including slope gradient and surface cover **d.** distance between the trail and the receiving water body **e.** inherent erodibility of the soil The first four of these five factors determine the hydrologic connectivity between the trail and the watercourse or water body. Watercourses are so important in managing the effects of OHV use on water quality that they have a BMP of their own (BMP 4.3). Techniques included in this BMP are intended to improve drainage and reduce or eliminate the hydrologic connectivity of trails and watercourses. The risk from OHV use can be managed by using the appropriate techniques from the following list, adapted as needed to local site conditions.	7. Locate steep trail segments on well-armored locations than can sustain traffic without accelerated erosion. **<u>Trail Design to Reduce Potential for Discharge of Pollutants to Surface Waters:</u>** 1. Design and space trail drainage structures to remove storm runoff from the trail surface before it concentrates enough to initiate rilling. 2. Design trails to dissipate intercepted water by rolling the grade. 3. Where trails cannot be effectively drained by rolling the grade or using reverse grades, provide trail drainage using OHV rolling dips as specified in Rolling Dips for Drainage of OHV Trails, USDA-Forest Service, Pacific SW Region, January, 2006. 4. Wherever possible, incorporate sediment basins at OHV rolling dip outlets instead of lead off ditches. 5. Where sediment basins cannot be installed, provide energy dissipaters at OHV rolling dip outlets. 6. Design trails to be no wider than necessary to provide the recreation experience defined in the trail management objective. 7. Incorporate design elements that discourage off-route use (for example, taking shortcuts, cutting new lines). 8. Extend drainage outlets beyond the toe of fill or side-cast. 9. Install aggregate, paver blocks, or other surfacing treatment on tread segments that are steep, erodible, or heavily traveled.
4.7.3	OHV Watercourse Crossings	To prevent or minimize the discharge of sediment into water bodies when locating, designing, constructing,	The importance of watercourse crossings in managing the effects of OHV use on water quality cannot be overemphasized. Of the pollutants generated by OHV use, sediment has by far the greatest volume. The greatest	**1. Crossing Locations—** **a.** Locate new OHV trails to limit the number of watercourse crossings to those necessary to meet planned activity objectives (see also BMP 4.1). **b.** Avoid long, steep OHV trail segments on approaches

BMP #	Title	Objective	Summary Explanation	Implementation
		reconstructing, and maintaining watercourse crossings.	potential for sediment delivery is at and near watercourse crossings where the potential for hydrologic connectivity is high. The approaches to watercourse crossings are typically constructed in native soils that can erode and deliver sediment to channels. Typical OHV watercourse crossings include low-water crossings, fords, bridges, arched pipes, culverts, and permeable fills. Crossing materials and construction vary based on the type of trail and kind of use. To minimize impacts to water quality, design new crossings to provide for the unimpeded flow of water, bed-load, large woody debris, and aquatic organisms. Watercourse crossings must be constructed with minimal disturbance to the streambed and to surface and shallow groundwater resources. The approaches to watercourse crossings and fill-slopes are especially important. All sediment resulting from erosion on these surfaces is delivered directly into the watercourse. Construction, reconstruction, and maintenance of watercourse crossings often require equipment to be in and near streams, lakes, and other aquatic habitats. Such disturbance can increase the potential for accelerated erosion and sedimentation by destabilizing stream banks or shorelines, removing vegetation and ground cover, and by exposing and compacting the soil. Permits, including Section 404 permits administered by the U.S. Army Corps of	to watercourse crossings. **c.** Orient stream crossings perpendicular to the channel in straight and resilient stream reaches. **2. Trail Approaches to Watercourse Crossings—** **a.** Where possible, make crossing approaches short and level, or reverse the grade if possible. **b.** Install cross drainage (cut-off waterbreaks) at crossings to prevent water and sediment from being channeled directly into watercourses. **c.** Locate cut-off waterbreaks as close to the crossing as possible without being hydrologically connected to the watercourse. **d.** Armor steep crossing approaches with stable aggregate or trail-hardening materials. **e.** Where possible (for example, at bridges or arch culverts), reverse the grade of the crossing approaches so runoff drains away from the watercourse. **3. Design of Watercourse Crossings–** **a.** Design crossing approaches and nearby drainage structures to minimize hydrologic connectivity. **b.** Design watercourse crossings to avoid diversion of flow down the trail should the crossing fail. **c.** Rocked diversion potential prevention dips and rock armoring of downstream crossing fill will be used to minimize potential for failure of trail-stream crossings. **d.** Design watercourse crossings for a 100-year storm event, to allow for unobstructed flow including bed-load and organic debris, and to provide for passage of desired aquatic and terrestrial organisms. **e.** Harden crossing approaches as needed to minimize soil displacement by traffic. **f.** Place stable materials below the outlets of cut-off waterbreaks to dissipate energy. **g.** Set crossing bottoms at natural levels of channel beds.

BM P #	Title	Objective	Summary Explanation	Implementation
			Engineers and Section 401 Water Quality Certifications administered by Regional Water Quality Control Boards may be required for in-stream work associated with stream-crossing construction and maintenance projects. The risk of sediment delivery at watercourse crossings can be managed by using the appropriate techniques from the following list, adapted as needed to local site conditions. Location, construction, and maintenance of watercourse crossings, and assessment of watercourse crossing condition, require consultation with qualified personnel.	**h.** Harden fords with gravel or cobble of sufficient size and depth to prevent movement by traffic. **i.** Construct watercourse crossings to sustain bankfull dimensions of width, depth and slope, and to maintain streambed and bank resiliency. **j.** Instead of pipe culverts, use bridges, bottomless arches, or buried pipe-arches for watercourses with identifiable floodplains and elevated trail prisms. **k.** Cross wet areas with naturally high water tables with permeable fills, perched culverts, and/or culvert arrays to maintain hydrologic function. **l.** Use Forest Service design specifications for bridges. **4. Construction of Watercourse Crossings--** **a.** Conduct construction operations during the least critical periods for water and aquatic resources (usually during low-water conditions and non-spawning/breeding seasons). **b.** Disturb as little area as possible when crossing watercourses. **c.** Minimize excavation of stream banks and riparian areas during construction. **d.** Keep excavated materials out of channels, floodplains, wetlands, and lakes. **e.** Stabilize adjacent areas disturbed during construction.
4.7.4	OHV Trail Construction & Reconstruc-tion	To prevent or minimize the discharge of sediment into water bodies during construction, reconstruction, and realignment of OHV trails.	Vegetation and ground cover is removed during trail construction and reconstruction, exposing the surface and subsurface soil to erosion. Temporary and long-term erosion control measures are necessary to minimize erosion and sediment delivery. The risk of erosion and sediment delivery from trail construction and reconstruction activities can be managed by using the appropriate techniques from the following list, adapted	Develop and implement an erosion and sediment control plan that describes: **1.** Amount of vegetative clearing and amount of soil material to be moved **2.** Proposed erosion control measures to prevent soil detachment and mobilization 3. Proposed sediment control measures to capture mobilized sediment **4.** Proposed sequence of implementation for erosion and sediment control treatments

BMP #	Title	Objective	Summary Explanation	Implementation
			as needed to local site conditions.	Maintain erosion and sediment control measures to function effectively to prevent discharges of pollutants to surface waters throughout the project area during trail construction and reconstruction. Keep erosion and sediment control measures sufficiently effective during ground disturbance to allow rapid closure and site stabilization if weather conditions deteriorate. For each project, specify a rainfall probability threshold (generally 30 to 50 percent, based on National Weather Service local forecasts) at which wet-weather sediment control measures will be installed. Complete all necessary stabilization measures prior to predicted precipitation that could result in surface runoff. Complete erosion and sediment control treatments before leaving project areas for the winter or rainy season. Do not operate equipment when ground conditions could result in excessive rutting, or runoff, that could deliver sediment directly to watercourses or water bodies. • When constructing trails near SMZs, do not permit side casting of soil into the SMZ. • Windrow slash and organic litter at the base of fill slopes to trap sediment. • Construct OHV rolling dips when soil moisture is sufficient to allow adequate compaction of OHV rolling dip drainage structures. • Close newly constructed trails for one season to allow consolidation of soils in treads and drainage structures, so treads and structures can better withstand OHV traffic.
4.7.5	OHV Trail Monitoring	To reduce the risk of sediment delivery to water, aquatic, and riparian resources by	The Forest Service will schedule systematic monitoring of OHV trails, activities and effects to detect existing and probable impacts to water quality, aquatic and riparian	Monitoring specific to OHV trails is included as follows: Conduct G-Y-R Trail Condition Monitoring as described in Revised OHV Trail Monitoring Form (GYR Form) and

BMP #	Title	Objective	Summary Explanation	Implementation
		identifying watercourse crossings and OHV trail segments in need of maintenance, by setting priorities for maintenance, and by identifying OHV areas and trails that require closure and restoration.	resources. If adverse water-quality effects are occurring, or there is a potential for substantial adverse impacts to water quality, the Forest Service will take immediate corrective action. Corrective actions may include, but are not limited to: **1.** Temporary or permanent erosion and sediment control treatments **2.** Barriers and signing to redistribute use **3.** Temporary closure of trails or areas until completion of corrective action **4.** Partial or total closure and restoration of trails or areas **5.** Reduction in the amount, type, or season of OHV use	Training Guide, USDA-Forest Service, Pacific SW Region, July 30, 2004, to identify trails and watercourse crossings in need of maintenance and to prioritize maintenance activities. Evaluate all watercourse crossings rated "red" during the G-Y-R Trail Condition Monitoring in consultation with a qualified watershed specialist. Schedule G-Y-R Trail Condition Monitoring so high-risk and high-maintenance trails are monitored annually; schedule the monitoring of stable trails less frequently, but not less than every 3 years. Monitor a 2.percent sample of trails each year using the Trail Assessment and Condition Survey (TRACS) protocol. Monitor the effectiveness of the OHV BMPs using the established the Pacific Southwest Region BMP effectiveness monitoring program. During routine inspections of OHV trails and while conducting photo point monitoring, use a standardized form to document and report newly created unauthorized OHV use, and trail segments with potential water-quality impacts. Temporarily close trails that pose immediate significant threats to water quality. As a minimum, install temporary erosion and sediment control treatments prior to the winter season. Permanently close and restore trails that cannot sustain OHV use without causing adverse effects to the beneficial uses of water per Water Quality Management Handbook objective 2 (page 8).

BMP #	Title	Objective	Summary Explanation	Implementation
4.7.6	OHV Trail Maintenance and Operations	To prevent or minimize discharges of sediment into watercourses and water bodies by maintaining OHV trails and associated drainage structures.	OHV trails are linear features constructed in native soil that concentrate runoff. Except for occasional hardened segments, trails are not typically surfaced with aggregate. In addition, normal OHV traffic tends to create an outside berm along the tread. Due to the presence of this berm, and to gradients typically steeper than roads, runoff from trails cannot be readily drained by crowning or out-sloping as it can for roads. Drainage and erosion control facilities cease to function if they are worn down by continued traffic. These factors make periodic maintenance and field inspection critically important in minimizing the impacts of OHV use on water quality. Trail drainage systems may further increase hydrologic connectivity if they deteriorate because of use, weather, or inadequate maintenance. Trail drainage facilities may become inadequate after wildfires or extreme precipitation events due to increased surface runoff, loss of vegetative cover, and stream bulking. New springs and seeps occasionally saturate trails after the occurrence of a wildfire or following unusually wet periods. Timely maintenance can correct these conditions. Drainage structures constructed with mechanized equipment last longer than hand-constructed drainage. However, trail maintenance with mechanized equipment such as SWECO-type trail tractors and mini-excavators can disturb soil, making it	**1. Maintenance Planning** Develop and implement annual maintenance plans based on the results of the G-Y-R and TRACS trail condition surveys and other periodic inspections (see BMP 4.7.5). Schedule maintenance to maximize the time period when soils are at optimal moisture levels for soil compaction. **2**. Inspection Periodically inspect, monitor, and assess trail condition to assist in setting maintenance priorities (see BMP 4.7.5). Identify the need for additional drainage structures, spot rocking, or trail hardening to protect and maintain water, aquatic, and riparian resources. **3.** After major storm events, to the extent staffing allows, inspect potential problem trails, drainage structures, and runoff patterns and, as needed: **a.** Clean out, repair, or reconstruct drainage structures that are not functioning **b.** Clear the tread of obstructions to traffic that could lead to trail braiding or off-site impacts **4. Maintenance Activities** As per Regional Forester's direction dated November 8, 2002, follow the maintenance standards and guidelines in A Field Evaluation of the Use of Small Trail Tractors to Maintain and Construct OHV Trails on National Forests in California, USDA-Forest Service Pacific SW Region, August 22, 2001. Specifically, these standards and guidelines are: **a.** Use certified operators, or persons under their direct supervision, to operate trail tractors and mini-excavators. **b.** Construct new trails using R-5 design standards. **c.** Close newly constructed trails to all use for one season. **d**. Construct OHV rolling dips using design standards **e.** Before moving equipment in, examine trails to determine the need for maintenance with mechanical

BM P #	Title	Objective	Summary Explanation	Implementation
			susceptible to erosion. Less aggressive maintenance is often necessary to minimize disturbance of stable sites. The construction of OHV rolling dips is from native soil material. For these structures to hold up under traffic they need to be well compacted. This requires moist soils and the scheduling of maintenance to exploit the narrow window of time when soil moisture is optimal for compaction. Obstructions to traffic such as fallen logs and potholes can lead to trail braiding, puddles, and off-trail traffic. Prior to opening trails for use—or periodically for trails open year-round—clearing trails of obstructions can reduce the need for repair and restoration. Volunteers do much of this work. Trail management objectives define the designed use, type of recreation experience, and the level of difficulty that a trail is designed to provide. It is important to maintain trails to the defined maintenance rotation, designed use and level of difficulty. The deterioration of trails to a more challenging difficulty level due to a lack of maintenance can affect water resources. More challenging trails often produce more sediment. The effects of trail maintenance activities on water quality are managed by using the appropriate techniques from the column on the right, adapted as needed to local site	equipment. **f.** Lift the blade and walk equipment across sections of trail that need no maintenance. **g.** Examine drainage structures, and the tread between them, for evidence of tread loss before starting maintenance. **h.** At failed drainage structures, determine the cause of failure before starting repairs. **i.** Recycle soil collected in rolling dip outlets into rolling dip structures or back into the trail tread. **j.** Do not blade outside berms off the trail as side-cast; work berms back into the trail tread. **k.** Repair rills and gullies in treads with soil reclaimed from rolling dip outlets or from outside berms, not with soil bladed from the trail tread. **l.** Blade soil sloughed from cutbanks, or from sideslopes above trails, only as needed to maintain a safe trail; do not undercut or blade into cutbanks. **m.** Repair "stutterbumps" by ripping, blading, and compacting the trail tread when soil is moist (except for non-cohesive soils). **n.** Move the smallest amount of soil necessary to meet the maintenance objective. **o.** Defer maintenance on drainage structures, or do hand maintenance, where soil is too dry or too wet for compaction. **p.** Maintain trail surfaces to dissipate intercepted water in a uniform manner along the trail by the use of OHV rolling dips. **q.** Groom trails as needed with a rock rake to keep drainage outlets open. **5.** Operations: • Restrict OHV travel to designated trails or designated motor vehicle use areas. • Prior to opening trails for use, clear obstructions to

BMP #	Title	Objective	Summary Explanation	Implementation
			conditions.	traffic to avoid braiding. • Close trails or restrict OHV use when the potential for sediment delivery is high or during periods when such use would likely damage the tread or drainage features (also see BMP 4.7.7).
4.7.7	OHV Wet Weather Operations	To prevent or minimize the discharge of sediment into water bodies by closing OHV trails to traffic when soil strength is low and trail treads and drainage structures are susceptible to damage.	Soil strength decreases as moisture increases. When soil strength is low, OHV traffic can lead to tread failure and damage to drainage structures, including OHV rolling dips. Damage to trail drainage structures increases the risk of sediment delivery to watercourses and water bodies. Soil is easily displaced when soil strength is low. Under these conditions OHV traffic near watercourses and on crossing approaches can result in direct delivery of sediment. The susceptibility of OHV trails to damage when soil strength is low varies with soil type, amount of traffic, and type of vehicle. Each OHV area has a unique combination of soil types and precipitation patterns that determine the appropriate implementation techniques to minimize impacts to water resources during wet weather.	To manage the potential for sediment delivery from OHV use when soils are wet, the Forest Service will use its authority under 36 CFR Section 261 to close designated OHV trails and areas to vehicular travel. This must be done seasonally by a given date, or be based on local conditions such as precipitation, or measurements of soil trafficability. Use the following techniques, as appropriate for local conditions, to manage OHV trail systems under wet weather conditions: **1.** Develop a wet-weather management plan. **2.** Close trails seasonally for the months when soil moisture is typically high and sedimentation is likely to occur; or **3.** Close trails for a core period when soil moisture is expected to be high, and extend the closure period as needed, based on precipitation or soil trafficability, or **4.** Determine the levels of soil strength and moisture at which OHV trail damage begins to occur for typical traffic, and close trails when measurements of soil strength predict a high risk of damage to drainage structures and trail treads. Identify benchmark locations where measurements of precipitation or soil trafficability will be taken to determine when trails will be closed. Identify trails, or loops of trails, with similar conditions that can be selectively closed. Identify and reroute or reconstruct trail segments that cause

BMP #	Title	Objective	Summary Explanation	Implementation
				entire trail systems to be closed because they retain moisture longer than is typical for the trail system.
4.7.8	Restoration of off-highway vehicle-damaged areas	To prevent or minimize the discharge of sediment into watercourses and water bodies by permanently restoring OHV-damaged areas, watercourse crossings, and OHV trails no longer designated for use.	Loss of surface duff, litter, and vegetation leaves soils exposed and easily eroded. Ruts and tracks created by OHV traffic are unnatural channels that concentrate surface runoff and increase its erosive power. OHV traffic can also compact soils, causing increased surface runoff. OHV traffic in wet meadows and marshes damages the root network that stabilizes sensitive soils. This can cause stream incision, which lowers the water table and results in a loss of meadow and riparian vegetation. OHV-damaged areas, and OHV trails no longer available for use, are identified during the route designation process at the forest and watershed level and during trail condition surveys and monitoring (see BMP 4.5). Identify additional trail segments for restoration when rerouting trails. Restoration of OHV-damaged areas and closed trails includes activities that stabilize and restore the landscape to a more natural state. Treatments can range from simply scattering slash or raking in duff and litter, to watercourse or meadow restoration, to using heavy equipment to break up compaction, fill in incised trails, reshape the area to its natural contour, and install drainage	**1. Restoration of Trails and OHV-damaged Areas** When planning the restoration of OHV-damaged trails and areas, consider the following steps taken from Restoration of OHV-damaged Areas - A Ten-Step Checklist, USDA-Forest Service, Pacific SW Region, May 31, 2006: **a.** Identify the source of the problem **b.** Effectively close the area to OHV traffic **c.** Reshape the land surface to its original contour **d.** Disperse concentrated runoff **e.** Prepare the seedbed **f.** Planting or seeding **g.** Stabilize the surface **h.** Signing **i.** Enforcement and monitoring **j.** Remove signs and barriers Few sites will require all ten steps. A more complete description of each step is included in the report. Additional information on restoring OHV-damaged areas can be found in Restoration of Off-Highway Degraded Landscapes (in press) USDA-Forest Service, San Dimas Technology and Development Center 2010. **2. Restoration of Watercourse Crossings** Restoration of watercourse crossings should be done under the direction of—or after consulting—a qualified watershed specialist. A permit may be required if in-channel work is necessary. When restoring OHV watercourse crossings, follow these general guidelines as appropriate: **a.** Remove all trail-hardening materials and fill, and

BM P #	Title	Objective	Summary Explanation	Implementation
			structures. Planting native vegetation helps stabilize slopes by absorbing the impacts of rainfall and overland flow. Effective closure from OHV traffic is essential to allow restored sites to recover. Accomplish restoration of OHV-damaged landscapes by using the appropriate techniques from the following list, adapted as needed to local site conditions.	restore the channel bottom to its natural gradient and width. **b.** If necessary, replace hardening material in the channel with cobble similar in size to the native bed-load. **c.** Restore crossing approaches to ensure that surface runoff does not reach the watercourse. **d.** If necessary to divert runoff from crossing approaches, install cutoff waterbreaks as close to the crossing as feasible without creating hydrologic connectivity. **e.** To the extent possible, reshape the streambanks to their former natural contour. **f.** Stabilize and revegetate the streambanks.
4.7.9	Concentrated-OHV-Use Area Management	To prevent or minimize the discharge of sediment, petroleum, and chemical products, or human waste into water bodies—and the contamination of groundwater by infiltration through soils—by planning, constructing, installing and maintaining drainage and runoff treatments at OHV staging areas, and by managing the risk of pollution at high-use and high-risk OHV areas.	Petroleum products and chemicals from spills during refueling, leaking, damaged or overturned vehicles, and from improper disposal practices can be a source of water contamination. Small amounts can be absorbed by the soil and broken down, but the risk of water contamination is often high in concentrated use areas located near watercourses and water bodies. Where sanitation facilities are not available or are inadequate, fecal matter and pathogens can enter water bodies. The risk of contamination from fecal matter and pathogens is highest in areas near water bodies with concentrated use. OHV staging areas sometimes constitute large areas with little or no infiltration capacity. Runoff from these areas is high and can transport sediment, nutrients, microbes, and other pollutants to any nearby watercourses or surface waters.	**Staging Areas--** • Locate new staging to avoid the potential for hydrologic connectivity with water bodies and watercourses. • Design OHV staging areas to accommodate the amount of use expected. • To determine necessary drainage, calculate the expected runoff using the appropriate design storm. • Include any run-on from adjacent areas in the calculation. • Armor new and existing high-use areas with protective materials appropriate for the site. • Except where the risk of groundwater contamination is high, armor with permeable pavements and/or integrate vegetative islands to trap and filter runoff. • Infiltrate as much of the runoff as possible in areas where the risk of groundwater contamination is low. • Where existing staging areas are located near watercourses or water bodies, and the potential for hydrologic connectivity is high, install a contour berm or trench around the perimeter to contain sediment and potential spills. • Provide permanent or temporary sanitation facilities as appropriate for the level of recreation use.

BM P #	Title	Objective	Summary Explanation	Implementation
			OHV staging areas are sometimes used for winter recreation. Snow removal from these facilities may adversely affect water, aquatic, and riparian resources. Plowing can physically displace native or engineered surfaces, damage drainage structures, or alter drainage patterns. Snow plowing may also remove protective soil cover such as vegetation and mulch. These changes can result in concentrated flow, increased erosion, and a risk of sediment delivery. The risk of delivering sediment, petroleum and chemical products, and human pathogens to water bodies at concentrated use areas can be reduced by using the appropriate techniques from the column on the right, adapted as needed to local site conditions.	• Adopt and implement a substance spill prevention, containment, and countermeasures (SPCC) plan. • Report hazardous spills and initiate appropriate clean-up action in accordance with applicable State and Federal laws, rules and regulations. **High Risk Areas and Events--** • Develop and implement a fuel and chemical management plan (for example. SPCC, spill response plan, emergency response plan) for permitted special events and at locations where the risk of overturned vehicles is high. For example, for extreme (highly technical) 4x4 trails and rock-crawling areas. • Clean up and dispose of spilled materials according to specified requirements in the event permit and plan. • Report hazardous spills and initiate appropriate clean-up action in accordance with applicable State and Federal laws, rules and regulations. • Provide temporary or permanent sanitation facilities as appropriate for the level of use. • Camping Areas • Provide permanent or temporary sanitation facilities at high-use areas, especially at campsites and day-use areas near water bodies, watercourses, and riparian areas and meadows. • As necessary and feasible, provide sanitation facilities at commonly used camping and resting sites and at other areas of concentrated use. • Provide education and training on the principles of backcountry sanitation, pack-it-in and pack-it-out.

Table 11. Special Use Permit Best Hydrologic Management Practices (BMPs) – Derived from the Recreation (12.41) chapter. *Summary of R5 FSH 2509.22 - SOIL AND WATER CONSERVATION HANDBOOK, CHAPTER 10 - WATER QUALITY MANAGEMENT HANDBOOK; Amendment No.: 2509.22-2011-1; Effective Date: December 5, 2011*

BMP #	Title	Objective	Summary Explanation	Implementation
4.6	Assuring That Organizational Camps Have Proper Sanitation and Water Supply Facilities	To protect the quality of water that is consumed by, and discharged from organizational camps under special use permit.	Organizational camps are required to comply with local public health and sanitation ordinances. Camp buildings and grounds must be supplied with at least the minimum sanitary facilities required by local codes. Water systems must provide an adequate volume of acceptably clean water for drinking, cooking, and general sanitation. Structures designed with toilets, showers, and washbasins will be planned and constructed to serve the camps' needs and meet sanitation and water-quality requirements.	Management requirements and controls to protect water quality through installation and maintenance of proper sanitation and water supply facilities must be incorporated into the special use permit for each organizational camp. Permittees are required to inspect their facilities and test their drinking water according to local codes and regulations to ensure a safe water supply and proper sanitation. Reports of these test results must be provided periodically to the Forest Service. Periodic inspection and monitoring of the camp by the authorized Forest Officer and county and State health officers are necessary to assure compliance.
4.10	Location of Pack and Riding Stock Facilities and Use Areas in Wilderness, Primitive, and Wilderness Study Areas	To avoid degradation of water quality from pack, riding stock facilities, and heavy-use areas.	This practice directs the location of pack and riding stock facilities to locations away from springs, streams, lakes, wet meadows, and other surface waters where pollution is likely to occur. This includes large camp sites and trails repeatedly used by customers of commercial stock operators and other recreational uses.	Forest Supervisors may authorize the construction and installation of simple temporary facilities when approved in the wilderness implementation plan, including corrals in connection with pack stock operation. Forest Supervisors may authorize the locations and use of large campsites for pack stock users and recreational users. If approved, facilities will not be located immediately adjacent to streams or lakes, and should generally be in place for no more than one season of use. The wilderness patrol will check the temporary livestock facilities authorized by the Forest Supervisor for compliance with the terms of the authorization.
7.5	See BMP 7.5 from Table 8, Veg. Mgmt.			

Table 12. Recreation (12.41) Best Hydrologic Management Practices (BMPs) – *Summary of R5 FSH 2509.22 - SOIL AND WATER CONSERVATION HANDBOOK, CHAPTER 10 - WATER QUALITY MANAGEMENT HANDBOOK; Amendment No.: 2509.22-2011-1; Effective Date: December 5, 2011*

BMP #	Title	Objective	Summary Explanation	Implementation
4.1	Sampling, Surveillance, and Sanitary Surveys of Primary Contact Recreation Waters	Ensure the health and safety of recreationists in primary contact waters, (e.g., hot springs, designated NFS swimming sites).	Sampling and testing for bacterial water quality (fecal coliform), pH, and clarity will be conducted at all developed, designated primary contact recreation water sites. A prescribed minimum number of tests for fecal coliform, pH, and clarity will be made during the site-use season. Tests for other biological pollutants and for chemical and physical character of the water will be made when there is reason to believe that water quality is not satisfactory for primary contact. Adjacent areas and the aquatic environment are surveyed to detect potential or existing hazards which may, or may not be demonstrated through water sample analysis from a single sample or short series of samples. The survey provides information needed in defining the cause(s) of contamination of primary contact recreation waters. Fecal coliform is used as the indicator for the potential presence of pathogens in the water because of the relative ease of detection and measurement. Analysis values are tested against standards for primary-contact recreation as stated by the County Health Departments, California RWQCB, and EPA ("Water Quality Criteria") swimming water-quality standards.	Each forest with designated primary contact recreation water sites will develop a water-quality monitoring plan for that site. This plan will identify water monitoring locations, data requirements, monitoring frequency, procedures, data analysis and interpretations, and reporting. If standards are exceeded, the area will be closed to all contact-recreation use until the cause, or causes have been identified and remedied. The Forest Supervisor will be responsible for closure. A sanitary survey will be made prior to the development of plans for each new primary-contact recreation facility. All areas where contact is specifically encouraged or permitted should have a sanitary survey conducted as soon as practical prior to use. Subsequent surveys will be repeated periodically in accordance with a prescribed schedule, usually annually, prior to the use season or following a change in the watershed condition; fire, flood, and so forth. All sanitary surveys must be conducted by a person trained in environmental sanitation and experienced in making such surveys. Results of the surveys are documented and provided to the Forest Supervisor and District Ranger for evaluation and action as appropriate.
4.2	Providing Safe Drinking	Provide safe drinking water to Forest Service facilities such as	Administrative guidelines for water source location and development; testing frequency and maximum	Location, design, sampling, and sanitary surveys will be performed by qualified individuals who are familiar with drinking water supply systems and

BMP #	Title	Objective	Summary Explanation	Implementation
	Water Supplies	campgrounds, picnic grounds, trailheads, visitor centers, winter sport areas, and developed roadside facilities.	contaminant levels for bacteriological, chemical, and physical contaminants; performance of sanitary surveys; closing, correction, and reopening of defective water systems; and documentation of data are provided in the EPA Drinking Water Standards, and State and local health department standards. The strictest standards will be followed for each individual item. When test results indicate that prescribed limits are exceeded, the water supply will be closed until the problem is corrected and satisfactory results are obtained. Seasonal systems will be tested and proven to be satisfactory prior to opening. Preventive measures will be taken in the location, construction, operation, and maintenance of water supply systems to minimize possibilities of contamination.	guidelines. Coordination and cooperation will be pursued with State or local health department representatives in all phases of drinking water system management. Sampling and testing frequencies vary depending on the water source, the number and type of user, and the type of test. Use State-certified laboratories if State, or local health departments do not perform water sample analyses
4.3	Documenting Water Quality Data	Assure water-quality data and related information is available for making water-quality management analysis and interpretations.	An inventory of the location of all designated potable water supplies and primary-contact recreation water sites will document pertinent site information such as times, dates, and results of all water-quality tests and surveys. This is an administrative record-keeping practice to establish a record of cause and effect to aid in identifying any sources of contamination.	The EPA STORET system will be the repository for water-quality data collected to monitor designated primary contact recreation water sites. Forests will use the computer-based "potable Water Supply Inventory" for site documentation of potable water supplies. Bacteriological test data will also be placed in a Forest Service computer for storage and review. Each forest will retain all laboratory test results for a minimum of 5 years (see also BMP 7.6).
4.4	Control of Sanitation Facilities	Protect surface and subsurface water from bacteria, nutrients, and chemical pollutants resulting from the collection, transmission,	Toilet facilities are provided at developed recreation sites. The type and number depends on the capacity of a given site. Sanitation facilities (which may vary from a portable toilet to a sophisticated treatment plant) will be planned, located, designed,	The appropriate disciplines will perform field investigations to evaluate soil, geological, vegetative, climatic, and hydrological conditions. The location, design, inspection, operation, and maintenance must be performed, or controlled by qualified trained personnel familiar with the

BMP #	Title	Objective	Summary Explanation	Implementation
		treatment, and disposal of sewage at Forest Service sites.	constructed, operated, inspected, and maintained to minimize the possibility of water contamination. Toilet facilities may also be made available at dispersed sites with the same goal of preventing water contamination.	sanitation system and operational guidelines. Proximity of toilets to open water and other sensitive areas will follow guidelines. State and local authorities will be consulted prior to the installation of new sanitation facilities or modification of existing facilities to assure compliance with all applicable State and local regulations. All phases of sanitation management (planning, design, inspection, operation, and maintenance) will be coordinated with State and local health departments and RWQCB representatives.
4.5	Control of Solid Waste Disposal	Protect water from nutrients, bacteria, and chemicals associated with solid waste disposal.	Encourage the users of NFS recreation facilities to cooperate in the proper disposal of solid waste, and to burn their combustible trash in fireplaces or stoves. Receptacles are provided for unburnables at most developed sites. Garbage and trash must be "packed out" by those who use dispersed sites and wilderness areas where receptacles are not available. Final disposal of collected garbage will be at a properly designed and operated county, or State sanitary landfill. Each landfill site will be located where groundwater and surface waters are at a safe depth and distance from the site, as prescribed in the provisions of the California Administrative Code, Title 23, chapter 3, Subchapter 15, and the State, or local regulations.	A public education effort to control refuse disposal will be a continuing process accomplished by using signs, printed information, mass media, and personal contact. Public cooperation is vital. Solid waste disposal plans, which define and describe collection, removal, and final disposal methods, will be maintained on each forest. Garbage containers will be placed in areas that are easily maintained and convenient for recreationists . Authorized Forest Officers may issue citations to violators.
4.6	Assuring That Organizational Camps Have Proper Sanitation and Water	Protect the quality of water that is consumed by, and discharged from organizational camps under special use permit.	Organizational camps are required to comply with local public health and sanitation ordinances. Camp buildings and grounds must be supplied with at least the minimum sanitary facilities required by local codes. Water systems must provide an adequate volume of acceptably clean water for drinking, cooking, and general sanitation. Structures designed	Management requirements and controls to protect water quality through installation and maintenance of proper sanitation and water supply facilities must be incorporated into the special use permit for each organizational camp. Permittees are required to inspect their facilities and test their drinking water according to local codes and regulations to ensure a

BMP #	Title	Objective	Summary Explanation	Implementation
	Supply Facilities		with toilets, showers, and washbasins will be planned and constructed to serve the camps' needs and meet sanitation and water-quality requirements.	safe water supply and proper sanitation. Reports of these test results must be provided periodically to the Forest Service. Periodic inspection and monitoring of the camp by the authorized Forest Officer and county and State health officers are necessary to assure compliance.
4.7	OHV Uses	Please refer to Road Management BMPs		
4.8	Sanitation at Hydrants and Water Faucets within Developed Recreation Sites	Maintain high water-quality standards around hydrants and faucets, which provide water for consumptive use in developed recreation site.	Regulations prohibit the cleaning, or washing of any personal property, fish, animal, or food at a hydrant or at a water faucet not provided for that purpose. The public must be informed of their responsibilities concerning sanitary regulations. Acceptable designated cleaning areas are located away from consumptive water sources and where effluent from the washing operation can be disposed of properly.	The forest officer authorized to administer developed recreation site regulations will inform the public of their sanitary responsibilities by posting signs on recreation site bulletin boards and at hydrants or faucets, by notices in newspapers, and by personal contact. Authorized forest officers may issue citations to violators.
4.9	Protection of Water Quality within Developed and Dispersed Recreation Areas	Protect water quality by regulating the discharge and disposal of potential pollutants.	This practice prohibits placing in, or near a stream, lake, or other water body, substances, which may degrade water quality. This includes, but is not limited to, human and animal waste, petroleum products, other hazardous substances, and sediment eroded from the site. Areas will be closed to restrict use or until the problem is mitigated.	Encourage the public through the use of signs, pamphlets, and public contact to conduct their activities in a manner that will not degrade water quality. Forest officers may accept and act on violations observed and reported by private citizens. Forest officers may issue citations to violators.
4.10	Location of Pack and Riding Stock Facilities and Use Areas in Wilderness, Primitive, and Wilderness Study Areas	Please refer to Special Use Permit BMPs		

Table 13. Mining (12.31) Best Hydrologic Management Practices (BMPs) – *Summary of R5 FSH 2509.22 - SOIL AND WATER CONSERVATION HANDBOOK, CHAPTER 10 - WATER QUALITY MANAGEMENT HANDBOOK; Amendment No.: 2509.22-2011-1; Effective Date: December 5, 2011*

BMP #	Title	Objective	Summary Explanation	Implementation
3.1	Water Resources Protection on Locatable Mineral Operations	To protect water quality from degradation by physical and chemical constituents resulting from locatable mineral operations, including exploration, development, production, and associated activities, on National Forest System (NFS) lands. To ensure that all mineral operations and associated activities are conducted in an environmentally sound manner and in compliance with applicable Federal and State water quality standards and requirements and that the operator reclaims the NFS lands disturbed by the mineral operations and associated activities by taking such measures to restore the NFS lands and to prevent or control damage to NFS lands including, but not limited	The occupancy and use of surface resources of NFS lands in connection with mining operations authorized by the United States 1872 Mining Law (30 USC §§ 21.54 et seq.), as amended, is subject to Forest Service regulation under the Organic Act (16 U.S.C. §§ 478 and 551). Forest Service regulations at 36 CFR Part 228, subpart A require the operator and the Forest Service to minimize adverse environmental impacts to the surface resources, including water quality, of NFS lands from mining operations and associated activities. See, 36 CFR 228.1.	**1.** Notice of Intent to Operate A Notice of Intent (NOI) is required from persons proposing to conduct mining operations which might cause significant disturbance of surface resources, including water quality, of NFS lands. The NOI must include sufficient information concerning the proposed mining operations and associated activities to allow the authorized officer determine whether the operator may proceed under the NOI or whether the operator must submit a proposed Plan of Operations for Forest Service approval before the mining operations and associated activities may be conducted. **2.** Plan of Operations Operators are required to submit a Plan of Operations if the proposed operations will likely cause, or are causing, a significant disturbance of surface resources, including surface waters. The authorized officer may determine that mining operations are causing or will likely cause significant disturbance of surface resources and require a Plan of Operations. When a Plan of Operations is required, operators are required to submit a proposed Plan of Operations to the Forest Service. The Forest Service must approve the Plan of Operations before the operator can conduct mining operations or associated activities. The Forest Service's approved Plan of Operations will incorporate the mitigation measures, controls and other requirements identified in the environmental document. When an operator is discharging, or proposes to discharge, waste, as that term is defined in Cal. Water Code §13050, in connection with mining operations or associated activities that could affect the quality of the waters of the state of

BMP #	Title	Objective	Summary Explanation	Implementation
		to, control of erosion, landslides, and water runoff.		California, the operator is required to file a report of waste discharge (ROWD) with the appropriate Regional Water Quality Control Board (Regional Board). When an operator is discharging, or proposes to discharge, pollutants to the navigable waters of the United States within California or is discharging, or proposes to discharge, dredged or fill material into the navigable waters of the United States within California, the operator must file a ROWD with the appropriate Regional Board. The Regional Board will determine whether the operator must obtain waste discharge requirements (WDRs) and/or a NPDES permit for the mining operations and associated activities. Additionally, when an operator proposes to discharge dredged or fill material into the navigable waters of the United States, the Army Corps of Engineers will determine whether the operator must obtain a 404 permit for the mining operations and associated activities. If the Forest Service determines that the mining operations and associated activities under the Plan of Operations may result in a discharge into navigable waters, for example when a NPDES permit or 404 permit is required, the operator must provide the Forest Service certification from the appropriate Regional Board that any discharge from the mining operations and/or associated activities is in compliance with the applicable requirements of the Clean Water Act, or has been waived as provided for in 42 U.S.C. §1341(1), before the Forest Service can approve the Plan of Operations. This certification is commonly known as "401 certification" (42 U.S.C. §1341 is also referred to as Section 401 of the Clean Water Act). The Forest Service shall include the substantive provisions of the WDRs and/or NPDES permit as terms and conditions in the Plan of Operations, which the Forest Service approves and administers. The Forest Service ensures that the operator complies with all terms and

BM P #	Title	Objective	Summary Explanation	Implementation
				conditions of the approved Plan of Operations. If the Regional Board does not require WDRs and/or a NPDES permit but the Regional Board provides comments, the comments will be considered during the authorized officer's evaluation of the adequacy of the proposed project's water-quality protection mitigation measures to be included in the Plan of Operations. Operators must comply with all applicable federal, state, and local laws and regulations when conducting mining operations and associated activities on NFS lands. **3**. Environmental Document The procedural requirements of the National Environmental Policy Act (NEPA) and its implementing regulations (43 C.F.R. Parts 1500-1508) must be followed in the environmental evaluation of a proposed Plan of Operations. The appropriate authorized officer will convene an interdisciplinary team to assess the impacts of the proposed mining operations and associated activities on the environment, formulate alternatives, and prescribe mitigation measures, controls, and other requirements. The environmental document will identify mitigation measures, controls, and other requirements for the proposed mining operations and associated activities. The Forest Service shall include the mitigation measures, controls, and requirement identified in the environmental document as terms and conditions in the Plan of Operations, which the Forest Service approves and administers. The Forest Service ensures that the operator complies with all terms and conditions of the approved Plan of Operations. **4**. Reclamation Bond If the operator is required to file a Plan of Operations, the Forest Service may require the operator to furnish a bond or other financial guarantee to cover the estimated costs of reclamation, including stabilizing, rehabilitating, and

BMP #	Title	Objective	Summary Explanation	Implementation
				reclaiming the area of operations. When a bond or other financial guarantee is required, the operator must furnish the required bond or other financial guarantee to the Forest Service prior to the Forest Service's approval of a Plan of Operations. Hence, mining operations and associated activities cannot be approved until the Forest Service receives the required reclamation bond. **5**. Special Use Permit Special use permits may be required for associated activities, such as water diversion, transmission facilities, and power lines. These permits may be authorized and issued by the Forest Service in conjunction with the approval of a Plan of Operations, when a Plan of Operations is required. **6**. Road use permit Road use permits may be required for commercial use of certain NFS roads. In this case, the appropriate BMP in Section 12.2 will apply. These permits may be authorized and issued by the Forest Service in conjunction with the approval of a Plan of Operations, when a Plan of Operations is required. **7**. Notice of Noncompliance When an operator fails to comply with Forest Service regulations at 36 C.F.R. Part 228, Subpart A or an approved Plan of Operations, and the noncompliance is causing injury, loss or damage to surface resource, including water quality, the authorized officer will issue the operator a "Notice of Noncompliance." This notice will describe the noncompliance, specify the actions to comply, and time frames within which to comply (generally not to exceed 30 days). In addition to a notice of noncompliance, civil and/or criminal enforcement actions are additional remedies that the Forest Service may pursue.
3.2	Administer-	To ensure that other	The Department of the Interior has the major	An interdisciplinary team will develop detailed mitigation

BMP #	Title	Objective	Summary Explanation	Implementation
	ing Terms of Bureau of Land Management (BLM)-Issued Permits or Leases for Mineral Exploration and Extraction on NFS Lands	resource values, including water quality, are protected during mineral exploration and extraction processing, and that reclamation activities carried out are under the terms of prospecting permits and mineral leases on NFS land.	role in issuing and supervising operations on mineral licenses, permits, and leases. The Forest Service coordinates with the Department of Interior agencies to ensure that Forest Service resource management goals and objectives are achieved, that impacts to the land surface resources are minimized, and that the affected land is promptly rehabilitated. Through the NEPA process, the Forest Service and BLM determine whether a prospecting permit or lease will be issued to an applicant. The decision is based primarily on whether the mineral operation, including the construction and maintenance of access roads and other associated facilities, can be done in a manner which adequately protects other resource values. The Forest Service and BLM develop the lease stipulations needed to protect water quality and other resources. All prospecting permits and leases require that an operating plan be prepared by the applicant and approved by the Forest Service prior to any ground-disturbing activities.	that will be written into the special stipulations section of prospecting permits and leases. These special stipulations are also required in the Operating Plan. On-the-ground checks for compliance with the stipulations of the lease, or operating plan will be the responsibility of the Forest Service official designated "Authorized Officer" who is usually the District Ranger, or Forest Supervisor. The BLM is primarily responsible for activities taking place on a lease site. By interdepartmental agreement, all applications to lease lands under Forest Service jurisdiction are referred to the Forest Service for review, recommendation, and development of special stipulations to prevent adverse impacts on the surface resources.
3.3	Administer-ing Common Variety Mineral-removal Permits	To ensure that resource values, including water quality, are protected to the maximum extent possible.	Mineral materials such as sand, stone, gravel, pumice, cinders, and clay will be sold when consistent with good public land management and when the sale is in the public interest. Permits and mineral material sale contracts will include reasonable erosion control measures, reclamation of the surface to a predetermined productive second use of the land, and revegetation. Material sales will	Removal is authorized by a Forest Service-issued mineral material permit or contract. Project location and detailed mitigation to prevent adverse effects to land surface resources will be developed through the environmental documentation process using an interdisciplinary team. These mitigations are then incorporated into the permit. Projects are implemented by the permittee following approval of an operating plan and reclamation plan, if

BMP #	Title	Objective	Summary Explanation	Implementation
			be approved if adequate measures can be implemented to minimize erosion and stream pollution, and if satisfactory arrangements can be made for restoration. If a choice of mineral deposit locations exists, extraction will be directed to those where the adverse effects of removal can be most readily controlled, or minimized (see also BMP 2.18).	warranted, and issuance of a mineral material permit. The District Ranger or their representative will ensure compliance with terms of the permit .

Appendix C

Guidelines for Capture, Moving, and Re-release of the Three Listed Sierra Nevada Amphibians

Authorization to handle and move the three listed Sierra Nevada amphibians:

For specific projects appended to this programmatic biological opinion, Forest Service biologists are authorized to capture, handle, move, and re-release individuals of the mountain yellow-legged frog and Yosemite toad. It is the responsibility of Forest Service biologists to use these guidelines to train other Forest Service personnel, contractors, or permittees, on the correct methods and procedures for dealing with individuals encountered in the project or permit area.

1. Capture, handling, moving, and release of the Sierra Nevada amphibians:

   a. In all cases, care must be taken to avoid injury or death of the animal.

   b. Individuals may be encouraged to move out of the danger zone without handling them.

      i. If capture is necessary, nets or bare hands may be used.

      ii. Soaps, oils, creams, lotions, repellents, or solvents of any sort cannot be used on hands within two hours before and during periods when the Forest Service biologist or other trained personnel are capturing and relocating individuals.

      iii. If the animal is held for any length of time in captivity, they shall be kept in a cool, dark, moist environment with proper airflow, such as a clean and disinfected bucket or plastic container with a damp sponge (see Guidelines in e below).

      iv. Containers used for holding or transporting shall not contain any standing water, or objects or chemicals that may injury or kill a Yosemite toad, Northern Distinct Population Segment of the mountain yellow-legged frog, and/or Sierra Nevada yellow-legged frog.

2. To avoid transferring disease or pathogens between suitable habitats during the course of translocating the three listed amphibians, Forest Service biologists or other trained personnel shall use the following guidance for disinfecting equipment and clothing. These guidelines are adapted from the Declining Amphibian Population Task Force's Code which can be found in their entirety at: http://www.open.ac.uk/daptf/

3. If suitable habitat is located immediately adjacent to the capture location, then the preferred option is relocation to that site.

4. An individual shall not be moved outside of the radius it would have traveled on its own unless suitable habitat is not located within that distance.

   a. The average movement distance for the mountain yellow-legged frog is ____; the average distance for a Yosemite toad _____.

   b. The individual should be carefully placed immediately adjacent to a log, rodent burrow, rock pile, or other suitable cover. The animal should be observed for at

least five minutes from the time of its release to ensure it is not vulnerable to predation, or other environmental stochasticity.

5. Under no circumstances shall they be relocated to a non-Forest Service property without the landowner's written permission.

6. If an individual is encountered, information on the incident should be included in the final compliance monitoring report for the appended project.